Fisheries and Oceans Science | Pêches et Océans Sciences

C S A S | **S C C S**

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Research Document 2001/158 | **Document de recherche 2001/158**

Not to be cited without permission of the authors * | Ne pas citer sans autorisation des auteurs *

Evaluation of a Box Crab (*Lopholithodes foraminatus*) Trap Test in British Columbia

Zane Zhang

Fisheries and Oceans Canada
Shellfish Stock Assessment Section
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C. V9T 6N7

ISSN 1480-4883
Ottawa, 2001

Canada

Abstract

A survey was carried out to test the effectiveness of five trap designs (large circular trap, modified Dungeness trap, prawn trap, Dorian top-loading trap, and Ladner top-loading trap) in catching box crabs in the northern Strait of Georgia in April 2001. Altogether 102 sets were made and 1724 box crabs were caught with 1096 males and 628 females. The modified Dungeness trap appears to be most suitable for future surveys based on an overall evaluation on the box crab catch rate, convenience of trap deployment, and the amount of by-catch. The paper also presents some new biological features on box crabs revealed by this survey, such as size and sex composition and distribution, relationship between carapace length and weight, relative abundance, shell conditions, relative number of egg-bearing females for different size groups. The paper also proposes recommendations as how we should proceed in the development of this potential fishery.

Résumé

Une étude de l’efficacité de cinq différents casiers (gros casier circulaire, casier Dungeness modifié, casier à crevettes, casier Dorian à chargement vertical, casier Ladner à chargement vertical) pour ce qui est de capturer le crabe à pattes trouées a été menée en avril 2001 dans le nord du détroit de Georgia. Les 102 mouillages effectués ont permis de récolter 1 724 crabes, dont 1 096 mâles et 628 femelles. Le casier Dungeness modifié semble le plus approprié pour mener d’autres études d’après une évaluation globale du taux de capture de crabe à pattes trouées, de la facilité de mouillage des casiers et des quantités de prises accessoires. Sont aussi présentées de nouvelles données biologiques sur l’espèce recueillies dans le cadre de l’étude, dont la distribution et la répartition par taille et par sexe, la relation entre la longueur de la carapace et le poids, l’abondance relative, la condition des carapaces et le nombre relatif de femelles oeuvées pour différents groupes de taille. Des recommandations sont proposées au sujet de la démarche à adopter pour développer cette pêche potentielle.

1. Introduction

Interest in developing a box crab trap fishery has persisted for the past few years. Under the guidelines for developing new fisheries (Perry et. al. 1999), a phase-0 review on the biology and fisheries of box crabs in British Columbia (B.C.) was presented to the Pacific Scientific Advice Review Committee (PSARC) in 1999 (Zhang et. al. 1999). Box crabs have never been commercially harvested, but have been caught as by-products in commercial ground fish and shrimp trawl fisheries, and prawn trap fishery in B.C. Box crab by-catch from shrimp trawl surveys was low. Two experimental fisheries were conducted on box crabs in the early 1990s. Box crab catch in these two experimental fisheries was also low, suggesting that the stock size might be small in B.C.

There has been a commercial fishery on box crabs in Oregon. Box crab fishermen in Oregon reported that box crabs like to live around the edges of rocky bottoms or on muddy bottoms near rocks in big patches. A preliminary study on some reproductive features of box crabs showed that females functionally mature at 78-83 mm in carapace length, and males start to mate possibly around 80 mm in carapace length and actively mate possibly around 106 mm in carapace length.

Due to the possible low abundance of box crab resource and little knowledge on their biology, PSARC recommended that considerable caution is required for the potential development of a box crab trap fishery. It was recommended to carry out surveys to determine the abundance of box crab population and obtain biological information that will help determine the feasibility of developing a box crab trap fishery.

A survey was proposed by the DFO in 2000, and a request for proposals (RFP) was sent to potentially interested individuals, organisations, first nations, and companies, inviting them to compete for participating in this box crab trap survey. Sointula Box Crab and Whelk Association was awarded to undertake the survey project, which was to be fulfilled in two stages. At stage 1, a survey was carried out to evaluate the effectiveness of several trap designs in catching box crabs and side-effects in by-catch of other species, and to provide some preliminary information on box crab biology, such as size and sex composition, distribution, and reproductive status. At stage 2, the preferred trap types defined after stage 1 are to be used to conduct a systematic survey to estimate the relative abundance of box crabs, and gain more detailed information on their productive and reproductive biology.

The first stage survey was carried out in the northern Straight of Georgia in a 10-day period in April 2001. This paper presents the findings from this survey and provides recommendations on how we might proceed with the development of this potential fishery.

2. Material and Methods

The main objective of the survey was to test five different trap types on the effectiveness of catching box crabs, the side effects of by-catching other species, and identifying an "ideal" trap type to be used in future surveys of box crab populations. The criteria for selecting an ideal trap type are: (1) a high catch rate for a wide range of sizes of box crabs; (2) a low by-catch rate for other species; and (3) ease of trap handling. A trap type, which is ideal for surveys, is not necessarily ideal for a fishery. The survey was also to provide some preliminary biological information on box crab, such as size and sex composition, distribution, and reproductive features.

2.1. Trap Design

The following five types of traps were tested in this survey:

Type 1: Circular trap with a diameter of 198 cm and a height of 30 cm. It has four gates with a width of 23 cm and a height of 10 cm. It is covered with 70×90 cm white mesh. Ten such traps, brought over by an Oregon fisherman, were used in the current survey.

Type 2: Modified Dungeness crab pot with a diameter of 107 cm and a height of 33 cm. It has, at the opposite sides of the pot, two enlarged gates with a width of 18 cm and a height of 13 cm. It is covered with 70×90 cm white mesh. Twenty such pots were used.

Type 3: Prawn pot with a diameter of 94 cm and a height of 32 cm. It has, at the opposite sides of the pot, two enlarged gates with a width of 18 cm and a height of 13 cm. It is covered with 70×90 cm black mesh. Twenty such traps were used.

Type 4: Dorian top-loading trap with a diameter of 107 cm and a height of 51 cm. A plastic entrance tunnel with a diameter of 20 cm and a depth of 15 cm was fitted onto the top entrance. It is covered with 2.5 cm red mesh. Twenty-five such traps were used.

Type 5: Ladner top-loading trap with a diameter of 107 cm and a height of 33 cm. The top entrance does not have a plastic entrance tunnel. It is covered with 2.5 cm black mesh. Twenty-five such traps were used.

2.2. Survey Locations

The survey was carried out from a 68-foot seine vessel, Teri Christina, between April 18 - 28, 2001 in the northern Strait of Georgia. Specific locations were chosen in an attempt to locate big aggregations of box crabs, so that the effectiveness of these trap types could be tested. An experienced Oregon box crab fisherman, Gene Law, was on board the survey vessel for the first few days of the survey and provided a considerable amount of advice on what he regarded as a good sounder signal for box crab habitat.

Criteria for setting traps include depth of 90 m, apparent bottom type (not too soft or too hard), and the cliff edges (EUI, 2001). This information was used throughout the project and also augmented with local knowledge obtained from recreational crab and commercial prawn fishermen (EUI, 2001). The survey was generally conducted in 14 locations (EUI, 2001, Fig. 1, Table 1).

Altogether 102 sets were made. Sixty-eight sets comprised a single trap of type 1, as these traps are too large to be deployed or retrieved in multiple traps per string. The other thirty-four sets were largely composed of 12 traps -- four of type 2, four of type 3, two of type 4 and two of type 5. Traps of type 1 were set in the immediate neighbourhood of a string of multiple trap types deployed on the same occasions. The inter-trap distance was either 18 m or 36 m. Eighty-nine sets were soaked overnight between 13 and 27 hours, and the other 13 sets were soaked over two-nights between 37 and 48 hours. Three traps, two of type 2 and one of type 4, were lost during the operation. The survey depth ranged between 20 and 146 m except for one occasion where a trap of type 1 was set 187 m deep (Table 2).

2.3. Bait

Two kinds of bait, herring and turbot, were used. Traps of type 2-5 were each baited with 1-kg frozen herring throughout the survey, and traps of type 1 were each baited with 3-kg freshly processed and iced turbot frames for the first 48 sets. For the remaining 20 sets, herring was used instead, as the quality of turbot had deteriorated. Nineteen of the 20 sets were baited with 3-5 kg of herring, and on one occasion 1-kg of herring was used for a trap of type 1 in Location 12. Five of the 20 sets were set in a location with a relatively high abundance of box crabs (location 7), whereas the other 15 sets were set in locations with low abundance of box crabs. Two traps of type 1 baited with turbot were also set in location 7, allowing a preliminary comparison of the bait effect on catching box crabs.

2.4. Biological Sampling

Altogether 1724 box crabs were caught with 1096 males and 628 females. The number and weight of box crabs and other species caught in each trap were recorded. Carapace length, carapace width and orbit lengths of 1626 box crabs were taken. In addition, sex, shell conditions (hard or new shell) and shell injuries were recorded. Lack or presence of epiphytic growths on the box crab was used as an important indicator of new and old shells respectively. In addition, older shells also seem to have additional blackening on the abdomen and on dentition of the main cheliped (EUI, 2001). Presence and color of eggs (yellow, orange, red, brown and black) were also noted, except for the first 14 sets. To detect the presence and color of eggs, the abdomen of the female needs to be pulled open, which was not realised until set 15. Thus, the 144 female box crabs caught in the first 14 sets were excluded in the analysis on reproductive characters of female box crabs.

2.5. Relative Abundance of Box Crab

To examine the effect of different soak duration on box crab catch, the amount of box crab catch was regressed against soak duration for each trap type in Location 1, 2, 6, 7 and 8. Significance of each regression coefficient (slope), which represents the rate of increase in catch over the length of the soak duration, was statistically tested (t-test).

Effectiveness of different trap types in catching box crabs need to be evaluated in locations with relatively high abundance of box crabs. To estimate the relative abundance of box crabs in each location, fishing effort (trap lift) for each trap type was standardised relative to the fishing effort for trap type 2 (modified Dungeness traps). Dungeness traps were used in an experimental box crab fishery in the Strait of Georgia in the early 1990s and a box crab survey in Oregon in 1997. They have also been mainly used in the commercial box crab fishery in Oregon. Standardisation was done based on the catch information from Location 1, 2, 6, 7 and 8, as box crabs appear to be relatively more abundant in these locations.

The rate of increase in catch of box crabs and large males only for trap type 1 is nearly significantly over the length of the soak duration (14-48 hours), but is not significant over the length of overnight soak duration (14-21 hours) in Location 1 (see results). Fishing effort (trap lift) for trap type 1 with overnight and over two-night soak was standardised separately. Fishing effort for the other four trap types was standardised regardless of soak duration, as in most cases the amount of box crab catch does not increase significantly with increase in soak hours (see results).

Fishing power coefficient for catch of box crab was calculated for each trap type as the ratio of average catch of box crabs by this trap type (catch rate) and average catch by trap type 2 in Location 1, 2, 6, 7 and 8. Fishing power coefficient for catch of large male box crabs was analogously calculated for each trap type as the ratio of average catch of large males by this trap type and average catch by trap type 2 in Location 1, 2, 6, 7 and 8. The overall fishing power coefficient (*OFPC*) for each trap type is calculated as a weighted average of the five fishing power coefficients with the number of trap lifts as the weight in the five locations:

$$OFPC = \frac{\sum_i w_i \times FPC_i}{\sum_i w_i}$$

where w_i and FPC_i are the number of trap lifts and fishing power coefficient respectively, and i denotes Location 1, 2, 6, 7 or 8. Effective fishing effort for each trap type was calculated by multiplying the actual fishing effort (number of trap lifts) by the corresponding overall fishing power coefficient. Relative abundance of box crabs in each location is represented by the standardised catch per unit effort (CPUE), which is calculated as the ratio of the total catch of box crabs by all traps and the summed effective fishing effort in this location.

2.6. Evaluation of Catching Efficiencies and Some Biological Features

The mean catches of box crabs by traps of the five types were compared, and the statistical significance was tested (unbalanced two-way ANOVA). By-catch for each trap type was also evaluated. Some new biological features on box crabs, such as size and sex composition, depth distribution, shell conditions, and characters of egg-bearing females, are also presented.

3. Results

3.1. Size Composition

Variations in weight (W) increase with carapace length (CL) for both male and female box crabs (Fig. 2, 3). Thus, the following model with a lognormal distribution error was used to describe carapace length and weight relationship:

$$W = A \times CL^{B} \times e^{\varepsilon} \qquad \text{or}$$
$$\log(W) = \log(A) + B \times \log(CL) + \varepsilon$$

where A and B are model parameters, and ε is an error of normal distribution with mean of zero. The estimated parameters together with other statistics were shown in Fig. 2 and 3, and Table 3. The model was used to estimate carapace lengths of the ninety-eight box crabs, whose carapace lengths were not taken in the survey.

The mean carapace length is 102 mm for males and 85 mm for females. The smallest male and female are, respectively, 48 mm (39 g) and 47 mm (34 g) in carapace length, and the largest male and female are, respectively, 153 mm (1638 g) and 123 mm (608 g) in carapace length (Fig. 4, 5). In this paper, male box crabs are categorised into two groups, small (CL < 100) and large (CL >= 100) group.

3.2. Bait Effect on Box Crab Catch

On average, 3.5 and 15.2 box crabs were caught, respectively, by the two traps of type 1 baited with turbot and by the five traps of type 1 baited with herring in Location 7. On average, 3 and 8 large male box crabs were caught, respectively, by the two traps baited with turbot and by the five traps baited with herring in Location 7 (Table 4). One of the five traps baited with herring caught a particularly high number (61) of box crabs, possibly because it was set on a spot with a particularly high density of box crabs around it. If this high catch is excluded, the average catch of box crabs and large males is 3.75 and 3.5 respectively for the four traps baited with herring. This average catch is comparable to that for the two traps baited with turbot suggesting that the effect of the two different baits, herring and turbot, on box crab catch might be small, although the bait effect is still uncertain due to such a small number of samples.

3.3. Effect of Soak Duration on Box Crab Catch

The amount of catch of box crabs were plotted against soak duration for each trap type in Location 1, 2, 6, 7 and 8 (Fig. 6-10). The amount of catch of large male box crabs were also plotted against soak duration for each trap type in Location 1, 2, 6, 7 and 8 (Fig. 11-15). The results (p-values) of the significance test on the linear regression coefficients (slopes) were shown in Table 5 and 6. In location 1, soak duration varied from 14 to 48 hours for trap type 1 and from 16 to 48 hours for trap type 2-5. The rate of increase in catch of box crabs over the length of this soak duration is not significantly different from zero at 0.05 significance level for each trap type, but the rate of increase is nearly significant (p=0.054) for trap type 1 (Table 5). When the analysis was carried out separately for overnight soak (14-21 hours), the rate of increase is not significant (p = 0.38). The rate of increase in catch of large male box crabs over the length of the soak duration (14 or 16-48 hours) is also not significant for each trap type, but the rate of increase is again close to significance (p=0.088) for trap type 1 (Table 6). When the analysis was carried out separately for overnight soak (14-21 hours), the rate of increase is not significant (p = 0.35). In Location 2, soak duration varied from 23 to 26 hours for trap type 1 and from 23 to 27 hours for trap type 2-5. The rate of increase in catch of box crabs over the length of this soak duration is not significant for trap type 1-4, but is significant for trap type 5 (p=0.035). Also, the rate of increase is nearly significant for trap type 2 (p=0.065) and for trap type 3 (p=0.053) (Table 5). The rate of increase in catch of large male box crabs over the length of this soak duration is not significant for any of the five trap types (Table 6). In Location 6, soak duration varied from 18 to 24 hours for trap type 1 and from 19 to 23 hours for trap type 2-5. The rate of increase in catch of box crabs over the length of this soak duration is significant, but negative, for trap type 4 (Fig. 8, Table 5). The rate of increase is not significant for trap type 1-3 and 5 (Table 5). The rate of increase in catch of large male box crabs over the length of this soak duration is significant, but negative, for trap type 1, and not significant for trap type 2-5 (Fig. 13, Table 6). In Location 7, soak duration varied from 13 to 23 hours for trap type 1 and from 17 to 23 hours for trap type 2-5. The rate of increase in catch of box crabs over the length of this soak duration is not significant for any trap types (Table 5). The rate of increase in catch of large male box crabs over the length of this soak duration is also not significant for trap type 1-4 (Table 6). Statistical test could not be conducted for trap type 5, as these traps did not catch any large male box crabs. In Location 8, soak duration varied from 22 to 47 hours for trap type 1 and from 22 to 48 hours for trap type 2-5. The rate of increase in catch of box crabs or large male box crabs over the length of this soak duration is not significant for any trap types (Table 5, 6).

The rate of increase in catch of box crabs for trap type 1 is nearly significantly over the length of the soak duration in Location 1. In most other cases, the amount of box crab catch does not increase significantly with increase in soak hours.

3.4. Relative Abundance

Fishing power coefficients for catch of box crab and large males for each trap type are shown in Table 7, and the overall fishing power coefficient for each trap type is presented in Table 8. The standardised CPUE for box crabs is 3.03 for the entire surveyed area (Table 9). The standardised CPUE is higher in Location 1, 2, 6, 7 and 8 with an average of 4.75, and lower in the other nine locations, indicating that box crabs are relatively more aggregated in the former five locations. The standardised CPUE for large male box crabs is 0.51 for the entire surveyed area (Table 10). The standardised CPUE is higher in Location 1, 2, 6, 7, 8 and 9, ranging between 0.55 and 1.59 with an average of 1.03 for large males only. The standardised CPUE is lower in the other eight locations, ranging between 0 and 0.36.

3.5. Effectiveness of Trap Types in Catching Box Crabs

As box crabs are relatively abundant in location 1, 2, 6, 7 and 8, catch information from only these locations was used to compare the effectiveness of the five different trap types. Effectiveness of a trap type in catching box crabs is represented by the mean catch rate (catch of box crab per trap lift). Comparison was made both for catching all kinds of box crabs and for catching large males with sets of over two-night soak excluded and included.

Trap type 1 is the most effective, and trap type 2 and 3 are more effective than trap type 4 and 5 in catching all kinds of box crabs or large males (Table 11, 12). The overall average catch rate (mean of the means of box crab catches per trap lift) is 13.4 for trap type 1, 5.7 and 3.9 for trap type 2 and 3, and 2.8 and 3.0 for trap type 4 and 5 respectively in catching all kinds of box crabs, when catches with over two-night soak are not considered (Table 11). The overall average is 14.9 for trap type 1, 5.5 and 3.6 for trap type 2 and 3, and 3.0 and 3.1 for trap type 4 and 5 respectively in catching all kinds of box crabs, when catches with over two-night soak are considered (Table 12). The overall average is 6.27 for trap type 1, 1.22 and 1.35 for trap type 2 and 3, and 1.05 and 0.87 for trap type 4 and 5 respectively in catching large male box crabs only, when catches with over two-night soak is excluded (Table 7). The overall average is 6.88 for trap type 1, 1.23 and 1.25 for trap type 2 and 3, and 1.16 and 0.80 for trap type 4 and 5 respectively in catching large male box crabs only, when catch information from over two-night soak is included (Table 12). Statistically, only trap type 1 is significantly more effective than the other trap types in each of the above cases. The difference between the other four trap types is not significant.

3.6. By-Catches

The most frequent by-catches were prawn, Dungeness crabs, red rock crabs and tanner crabs. Other by-catch species were minimum in both number and weight (Table 13). The amount of prawn by-catch by trap type 1 and 2 is negligible due to large mesh size. Prawn was mainly caught by trap type 3, 4 and 5 (Table 14). By-catch of Dungeness, red rock and tanner crabs combined was between 0.2 and 0.5 pieces or between 0.1 and 0.2 kg per trap in Location 1, 2, 6, 7, and 8. By-catch of these crabs was higher, ranging between 0.6 and 1.6 pieces or between 0.2 and 0.7 kg per trap in the entire surveyed area. The amount of by-catch of Dungeness, red rock and tanner crabs combined was similar among trap type 2, 3, 4 and 5. Traps of type 1 caught considerably smaller amount of these crabs in Location 1, 2, 6, 7 and 8, while they caught considerably larger amount of these crabs in the entire surveyed area. In Location 11 and 12, few box crabs but mainly Dungeness crabs were caught. About 78% of Dungeness crabs were caught by traps of type 1 from these two locations.

3.7. Comparison of Relative Abundance of Box Crabs

In the early 1990s, a fisherman fished for box crabs at the north end of the Thormanby Island using Dungeness trap pots. He caught 1481 box crabs with 729 trap pulls with a catch rate of about 2 box crabs per trap. The standardised CPUE (catch per Dungeness trap lift) in location 1, 2, 6, 7, 8 is 4.75, suggesting that the abundance in these locations is possibly higher, although the modified Dungeness traps used in the current survey are higher and their gates are larger.

In 1997, Oregon Department of Fish and Game conducted a survey in four locations between Newport and Florence, Oregon in a depth range of 120-156 m on April 18-19 and 24-26 1997 (Zhang et. al. 1999). Standard Dungeness crab traps were used with mackerel and squid as baits, and most traps were set in the afternoon and retrieved the following morning for an average of 15-hour soak. Abundance of box crabs was high in two locations and very low in the other two locations. The CPUE (catch per trap lift) in the two abundant locations was more than 5 times as high as that in location 1, 2, 6, 7, 8 in the current survey (Table 15).

Mesh size is large for traps of type 1 and 2, and small for traps of type 3, 4 and 5. The average carapace length of male and female box crabs caught by traps of type 1 and 2 is 102.6 mm and 86.1 mm respectively. The average carapace length of male and female box crabs caught by traps of type 3, 4 and 5 is 101.1 mm and 82.6 mm respectively. The difference between the mean carapace lengths of males is not significant, whereas the difference between the mean carapace lengths of females is significant. Both males and females caught by traps of type 1 and 2 from the current survey are, on average, significantly smaller than males and females caught in the Oregon survey (Table 16).

3.8. Depth Distribution, and Size and Sex Composition

The standardised CPUE is relatively high in the depth range between 76 and 150 m and low in the depth range between 20 and 75 m (Fig. 16). The highest standardised CPUE occurs in the depth from 101 to 125. The percentage of large individuals (CL>= 100 mm) decrease for both sex, while the fishing depth increases (Fig. 16). The proportion of large males in the depth between 20 and 50 m is more than twice as high as that in the depth between 76 and 150 m. The proportion of large females in the depth between 20 and 50 m is almost 11 times as high as that in the depth between 76 and 150 m. One trap of type 1 was set at a depth of 187 m, and it caught 12 small box crabs without a single large one. The percentage of male box crabs in the aggregated locations (Location 1, 2, 6, 7 and 8) varied, on average, from 57 to 71 % (Table 17).

3.9. Injury

Box crabs sustained a low level of injuries, which include deformed shell, holes in the shell, town tason, regenerated legs or claws. Among the captured box crabs, 1.55% of males and 0.48% of females were found to be injured (Table 18).

3.10. Shell Condition

Most of the box crabs had new shells; 71.5% males and 57.5% females contained new shells (Table 19). The mean carapace length of old shells is 113 mm for males and 91 mm for females, significantly larger than the mean carapace length of males and females of new shells (Table 19).

There is a higher proportion of new shells among females without eggs than with eggs. Among females with eggs the proportion of new shells decreased from 69% to 0%, as egg color gets darker from yellow, orange, red, brown and black (Table 20). Mean carapace length of females without eggs is significantly smaller than that of females with eggs of orange color or darker. Females with eggs of yellow colors are also, on average, significantly smaller than those with eggs of orange or darker (Table 20). The percentage of females with eggs increases with the size. Among box crabs with a carapace length of approximately 80 mm, 50% of them bear eggs. When they are around 90 mm in carapace length, approximately 95% bear eggs (Table 21).

4. Discussion

Trap type 1 is most effective in catching box crabs, probably because of more room within the trap and possibly also due to larger amount of bait used. Catch of box crabs increased (almost significantly) for traps of type 1 over the length of the entire soak duration (14-48 hours). The average rate of catch of box crabs and large males for trap type 1 is, respectively, about 2.5 and 5.5 times as high as that for the trap type 2. However, these large traps could only be deployed and retrieved singularly in each set due to their heavy weight, whereas traps of the other types can be set in multiple numbers in each set. It is, therefore, more likely to catch more box crabs with a set employing, for instance, 10-20 traps of type 2 than a set employing a single trap of type 1. In addition, it is more demanding to deploy and retrieve traps of type 1 due to their large size and heavy weight. Thus, trap type 2 appears to be more suitable for use in future box crab surveys than trap type 1.

The average rate of catch of box crabs for trap type 2 is approximately 1.5 times as high as that for trap type 3, and almost 2 times as high as for trap type 4 or 5. The average rate of catch of large male box crabs for trap type 2 is slightly higher than that for trap type 4 or 5, and slightly lower than trap type 3. For the sake of surveys, it is of greater concern to have a trap type capable of catching all sizes of box crabs than catching large ones. In addition, traps of type 3, 4 and 5 have the shortcoming of by-catching a considerable amount of prawn, whereas prawn by-catch is negligible for traps of type 2.

This survey offers an opportunity to examine the relative abundance of box crabs in the surveyed area. Catch of large male box crabs per standardised effort (relative to type 2 trap) is only 1.03 in the box crab aggregated locations. Although the CPUE was higher than that in the experimental fishery in the early 1990s, it was 5 times as low as that in the Oregon's survey in 1997, indicating again that the resource of box crabs is probably low in B.C. In addition, the average size of box crabs in the surveyed area was also significantly smaller than that from Oregon. The smallest box crab caught is 47 mm in carapace length. Among the box crabs caught, the proportion of very small box crabs was low, although considerable amount of prawn were retained. Small box crabs might live in a different habitat or the bait used might not be so attractive to them.

The abundance of box crabs appears to be higher in the depth range of 76-150 m than that of 20-75 m. This depth range with a relatively high abundance of box crabs agrees well with what has been reported (Zhang et. al. 1999). A higher proportion of larger male and female box crabs were caught with decrease in depth, and male and female box crabs do not appear to live separately, suggesting that these large box crabs might have come to the shallower waters for spawning. When females reach 75-84 mm in carapace length, 50% of them bears eggs. The size of female maturity is similar to that in Oregon, where females begins to bear eggs at 78-83 mm in carapace length (Goddard 1997).

Female box crabs holding new egg clutches (yellowish eggs) are composed of both new shell (69%) and old shell (31%) crabs, suggesting that female box crabs might be capable of breeding in both soft and hard shell states.

5. Recommendations

The catch rate for large male box crabs is low, despite that the surveyed locations were chosen with some previous experience on box crab catch distribution and habitat. If this species continues to be considered for a commercial fishery, then the following recommendations are proposed.

1. **The preferred trap type for a survey (and possibly for a fishery) is type 2 (modified Dungeness trap).** The box crab catch rate is higher for this trap type than for trap type 3, 4 and 5. The amount of prawn by-catch is negligible for this trap type, but is of concern for the latter three types. Traps of type 1 can only be set singularly for each set, although the box crab catch rate is the highest for this trap type. More box crabs could be sampled in a set having multiple number of traps of type 2 than a

set containing only a single trap of type 1. It is also easier to set traps of type 2 than of type 1.

2. **A systematic distribution survey is to be carried out to gain more detailed information on box crab biology, such as distribution, relative abundance, and reproductive characters.** Change-in-ratio method may be used to investigate the abundance of box crab resource**.** A survey is carried out to remove all large males, before another survey is conducted in the same area. Abundance is estimated based on the change in the ratio of large males to small males plus all females (Chen et al. 1998). It was found from the Oregon box crab survey that the degree of damage to the male genital pore setae is positively related to male mating behaviour. This preliminary finding need to be verified in order to more reliably determine the size of males, when they begin to actively mate.

6. Acknowledgements

I would like to thank Greg Workman for his thorough review of this paper with many good points, which helped to enhance the quality of the paper. I am also grateful to Dr. Ian Perry, Geoff Krause and Inja Yeon for their reading of the paper and providing many constructive suggestions.

7. References

Chen, C.-L., J.M. Hoenig, E.G. Dawe, C. Brownie, and K.H. Pollock. 1998. New developments in change-in-ratio and index-removal methods, with application to snow crab (*Chionoecetes opilio*). P. 49-61. In G.S. Jamieson and A. Campbell. (eds.). Proceedings of the North Pacific symposium on invertebrate stock assessment and management. Can. Spec. Publ. Fish. Aquat. Sci. 125.

EUI, 2001. Project report for the box crab trap evaluation study 2001. Report prepared for Sointula Box Crab and Whelk Association.

Goddard, J. 1997. Size at maturity in box crabs, *Lopholithodes foraminatus* , from Oregon. Report prepared for the Oregon Department of Fish and Wildlife. 7 pp.

Perry, R.I., C.J. Walters and J.A. Boutillier. 1999. A framework for providing scientific advice for the management of new and developing invertebrate fisheries. Rev. Fish Biol. Fish. 9:125-150.

Zhang, Z.Y., G. Workman, and A.C. Philips. 1999. A Review of the Biology and Fisheries of the Box Crab (*Lopholithodes foraminatus Stimpson*) in British Columbia. Canadian Stock Assessment Secretariat Research Document 99/131.

Table 1. The survey locations

Location	Sets	Average Depth	Location
1	1-7, 17-19, 21-28	109	Northen end of Lasqueti Island
2	8-16, 20	103	Central western bays on Texada Island
3	29-31	96	Georgia Strait off Qualicum Beach
4	32-38	105	South-western shore of Lasqueti Island
5	39-41	88	Northern end of Texada Island (Limekiln Bay)
6	42-44, 54-55, 65-66	49	South-western shore of Harwood Island
7	45-47, 88-90, 99-102	52	Mianland shore off Powel River
8	48-53, 56-59, 63-64	59	North-western shores of Harwood Island
9	60-62, 91-95	42	Mianland shore north off Powel River pulpmill
10	67-68, 73-77	64	Banks south of Savary Island
11	69-72	54	Northern side of Savary Island in Keefer Bay
12	78-85	61	Eastern Shore of Hernando Island
13	86-87	68	Mainland shore south of Lund
14	96-98	63	Eastern Shore of Harwood Island across from Powel River

Table 2. The number of trap lift at different depth ranges for each trap type

Depth Range (m)	Type 1	Type 2	Type 3	Type 4	Type 5	Sum
20-50	14	59	59	31	29	192
51-75	19	10	13	7	6	55
76-100	19	17	20	10	12	78
101-125	24	27	29	10	17	107
126-150	1	16	16	7	9	49
187	1	0	0	0	0	1

Table 3. Carapace length (CL) and weight (W) relationship for box crabs: log(W) = log(A) + B*log(CL)

	log(A)	B	Residual Srandard Error	Degrees of Freedom	R^2
Male	-8.8117	3.2247	0.07224	1041	0.99
Female	-7.9374	3.0111	0.06664	581	0.98

Table 4. Catch of box crabs by traps of type 1 baited with turbot or herring in Location 7

Bait	Soak Hours	Catch of Box Crab	Catch of Large Male Box Crab
Turbot	23	6	5
Turbot	23	1	1
Herring	21	0	0
Herring	21	2	2
Herring	13	10	9
Herring	17	3	3
Herring	17	61	26

Table 5. Statistics of the significance test on the slope of the linear regression of box crab catch against soak duration for each of the five trap types

Trap Type		Location 1	Location 2	Location 6	Location 7	Location 8
1	Sample Size	12	7	4	7	8
	p-value	0.054	0.646	0.292	0.419	0.301
2	Sample Size	24	11	11	13	16
	p-value	0.807	0.065	0.148	0.355	0.453
3	Sample Size	25	12	12	11	16
	p-value	0.551	0.053	0.288	0.235	0.413
4	Sample Size	10	4	8	6	8
	p-value	0.345	0.37	**0.033**	0.343	0.673
5	Sample Size	13	8	4	6	8
	p-value	0.544	**0.035**	0.263	0.435	0.455

Table 6. Statistics of the significance test on the slope of the linear regression of large male box crab catch against soak duration for each of the five trap types

Trap Type		Location 1	Location 2	Location 6	Location 7	Location 8
1	Sample Size	12	7	4	7	8
	p-value	0.088	0.235	**0.049**	0.268	0.450
2	Sample Size	24	11	11	13	16
	p-value	0.253	0.318	0.664	0.844	0.600
3	Sample Size	25	12	12	11	16
	p-value	0.913	0.546	0.423	0.291	0.150
4	Sample Size	10	4	8	6	8
	p-value	0.527	0.434	0.837	0.343	0.593
5	Sample Size	13	8	4	6	8
	p-value	0.948	0.153	0.509	N/A	0.722

Table 7. Fishing power coefficient for each trap type relative to trap type 2

Trap Type	Number of Trap Pulls	Catch of Box Crab	Catch of Large Males	Catch of Box Crab per Trap	Catch of Large Males per Trap	FPC1	FPC2
Location 1							
1	6	91	37	15.17	6.17	2.28	5.69
1 *	6	195	82	32.50	13.67	4.88	12.62
2	24	160	26	6.67	1.08	1.00	1.00
3	25	91	22	3.64	0.88	0.55	0.81
4	10	35	9	3.50	0.90	0.53	0.83
5	13	58	9	4.46	0.69	0.67	0.64
Location 2							
1	7	90	24	12.86	3.43	2.62	7.54
2	11	54	5	4.91	0.45	1.00	1.00
3	12	43	9	3.58	0.75	0.73	1.65
4	4	9	1	2.25	0.25	0.46	0.55
5	8	20	4	2.50	0.50	0.51	1.10
Location 6							
1	4	53	27	13.25	6.75	1.29	2.97
2	11	113	25	10.27	2.27	1.00	1.00
3	12	72	21	6.00	1.75	0.58	0.77
4	8	55	18	6.88	2.25	0.67	0.99
5	4	21	5	5.25	1.25	0.51	0.55
Location 7							
1	7	83	45	11.86	6.43	3.28	4.64
2	13	47	18	3.62	1.38	1.00	1.00
3	11	13	11	1.18	1.00	0.33	0.72
4	6	7	7	1.17	1.17	0.32	0.84
5	6	2	0	0.33	0.00	0.09	0.00
Location 8							
1	7	97	60	13.86	8.57	6.93	9.14
2	16	32	15	2.00	0.94	1.00	1.00
3	16	63	28	3.94	1.75	1.97	1.87
4	8	11	10	1.38	1.25	0.69	1.33
5	8	18	14	2.25	1.75	1.13	1.87

*	Over two night soak
FPC1	Fishing power coefficient for catching box crabs
FPC2	Fishing power coefficient for catching large male box crabs (CL >= 100 mm)

Table 8. Weighted average fishing power coefficient for each trap type relative to trap type 2 in catching all kinds of box crabs and large male box crabs

Trap Type	1	1*	2	3	4	5
All Box Crab	3.39	4.88	1.00	0.85	0.54	0.62
Large Males	6.17	12.62	1.00	1.14	0.93	0.86

* Over two night soak

Table 9. Standardised catch per unit effort for catching box crabs in each surveyed location

Location	Total Catch	Standardised Fishing Effort	CPUE
1	630	108.26	5.82
2	216	52.05	4.15
3	4	19.00	0.21
4	53	42.17	1.26
5	23	16.58	1.39
6	314	41.55	7.56
7	152	53.04	2.87
8	227	67.47	3.36
9	59	46.10	1.28
10	24	36.16	0.66
11	0	19.89	0.00
12	17	44.80	0.38
13	2	6.79	0.29
14	3	15.97	0.19
Overall	1724	569.82	3.03

Table 10. Standardised catch per unit effort for different sizes of large male box crabs in each location

Location	(CL>=100)	(CL>=110)	(CL>=120)	(CL>=130)
1	1.00	0.52	0.19	0.05
2	0.55	0.25	0.06	0.01
3	0.00	0.00	0.00	0.00
4	0.05	0.02	0.00	0.00
5	0.16	0.08	0.08	0.00
6	1.59	1.14	0.58	0.18
7	1.02	0.74	0.34	0.16
8	1.25	1.05	0.74	0.28
9	0.76	0.68	0.46	0.18
10	0.36	0.33	0.27	0.05
11	0.00	0.00	0.00	0.00
12	0.18	0.15	0.05	0.02
13	0.16	0.16	0.16	0.08
14	0.12	0.12	0.08	0.04
Overall	0.51	0.38	0.22	0.08

Table 11. Mean catch of box crabs per trap in location 1, 2, 6, 7 and 8 with overnight soak

Mean Catch of Box Crab per Trap

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	15.17	7.38	4.38	2.71	5
2	12.86	4.91	3.58	2.25	2.5
6	13.25	10.27	6	6.88	5.25
7	11.86	3.62	1.18	1.17	0.33
8	13.86	2.33	4.42	1.17	1.83
Overall Average	13.40	5.70	3.91	2.84	2.98

Mean Catch of Large Male Box Crab per Trap

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	6.17	0.94	1	0.57	0.78
2	3.43	0.45	0.75	0.25	0.5
6	6.75	2.27	1.75	2.25	1.25
7	6.43	1.38	1	1.17	0
8	8.57	1.08	2.25	1	1.83
Overall Average	6.27	1.22	1.35	1.05	0.87

Number of Trap Pulls

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	6	16	16	7	9
2	7	11	12	4	8
6	4	11	12	8	4
7	7	13	11	6	6
8	7	12	12	6	6

Table 12. Mean catch of box crabs per trap in location 1, 2, 6, 7 and 8 with overnight soak and over two-night soak combined

Mean Catch of Box Crab per Trap

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	23.83	6.67	3.64	3.50	4.46
2	12.86	4.91	3.58	2.25	2.50
6	13.25	10.27	6.00	6.88	5.25
7	11.86	3.62	1.18	1.17	0.33
8	12.88	2.00	3.73	1.38	2.78
Overall Average	14.93	5.49	3.63	3.03	3.06

Mean Catch of Large Male Box Crab per Trap

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	9.92	1.08	0.88	0.90	0.69
2	3.43	0.45	0.75	0.25	0.50
6	6.75	2.27	1.75	2.25	1.25
7	6.43	1.38	1.00	1.17	0.00
8	7.88	0.94	1.87	1.25	1.56
Overall Average	6.88	1.23	1.25	1.16	0.80

Number of Trap Pulls

Area	Trap Type 1	Trap Type 2	Trap Type 3	Trap Type 4	Trap Type 5
1	12	24	25	10	13
2	7	11	12	4	8
6	4	11	12	8	4
7	7	13	11	6	6
8	8	16	15	8	9

Table 13. By-catches of the survey

Scientific Name	Common Name	Entire Area Number	Entire Area Weight (kg)	Location 1, 2, 6, 7 and 8 Number	Location 1, 2, 6, 7 and 8 Weight (kg)
Pandalus platyceros	Prawn	2277	68.22	1261	37.77
Cancer magister	Dungeness Crab	326	151.88	61	31.22
Cancer productus	Red Rock Crab	64	14.51	23	4.87
Chionoecetes bairdi	Tanner Crab	41	9.7	23	5.95
Hydrolagus colliei	Spotted Ratfish	32	25.93	8	4.08
Pycnopodia helianthoides	Sunflower Starfish	15	6.35	2	1
Cancer gracilis	Slender Crab	14	1.37	0	0
Asteriodea	Starfish	9	4.6	3	2.1
Acantholithodes hispidus	Bristly Crab	7	0.66	3	0.42
Pagurus	Hermit Crab	6	0.19	4	0.08
Sebastes caurinus	Copper Rockfish	5	7.7	3	4.7
Octopus dofleini	Giant Pacific Octopus	4	20	1	9
Squalus acanthias	Spiny Dogfish	3	6.5	1	2.5
Ophiodon elongatus	Lincod	2	5	2	5
Sebastes ruberrimus	Yelloweye Rockfish	2	5	2	5
Sebastes maliger	Quillback Rockfish	2	3.5	2	3.5
Myoxocephalus polyacanthocephalus	Great Sculpin	2	1.13	1	0.13
Gadus macrocephalus	Pacific Cod	1	1	0	0
Cottidae	Sculpin	1	0.7	0	0
Leptasterias hexactis	Six-ray Starfish	1	0.5	1	0.5
Luidia foliolata	Sand Star	1	0.07	0	0
Fusitriton oregonensis	Oregontriton	3	0.04	1	0.04
Porichthys notatus	Plainfin Midshipman	1	0.03	0	0

Table 14. By-catches by different trap types

By-catch in the entire surveyed area

Trap Type	Trap pulls	Average catch of prawn per trap in pieces	in weight (kg)	Average catch of crabs per trap * in pieces	in weight (kg)
Type 1	68	0.01	0.00	1.56	0.69
Type 2	129	0.08	0.00	0.82	0.35
Type 3	138	8.92	0.27	0.83	0.34
Type 4	65	7.58	0.23	0.92	0.32
Type 5	72	7.53	0.23	0.63	0.23

By-catch in Location 1, 2, 6, 7 and 8

Trap Type	Trap pulls	Average catch of prawn per trap in pieces	in weight (kg)	Average catch of crabs per trap * in pieces	in weight (kg)
Type 1	38	0.00	0.00	0.16	0.09
Type 2	75	0.13	0.00	0.51	0.23
Type 3	76	8.04	0.24	0.37	0.13
Type 4	36	7.03	0.21	0.50	0.18
Type 5	39	9.92	0.30	0.44	0.13

* Including Dungeness, Red Rock and Tanner Crabs

Table 15. Comparison of CPUE among the current survey, the early 1990s survey and Oregon's survey

Survey	Locations	Catch of box crabs	Trap Pulls***	CPUE
Current	Abundant Locations*	1539	322.4	4.77
	Less Abundant Locations **	185	247.5	0.75
Early 1990s' catch	Thormanby Island	1481	729	2.03
Oregon survey	Abundant Locations	2955	116	25.47
	Less Abundant Locations	28	46	0.61

* Location 1, 2, 6-8
** Location 3-5, 9-14
*** Equivalent to the number of lifts of modified Dungeness trap pots

Table 16. Differences in sizes of box crabs caught in the current survey and the Oregon survey

	Male Current Survey Trap Type 3, 4 and 5	Current Survey Trap Type 1 and 2	Oregon Survey
Mean Length	101.1	102.6	106.5
Standard Deviation	22.6	18.7	13.0
Minimum	48	55	69
Maximum	153	144	144
Number of Sample	365	731	364

	Female Current Survey Trap Type 3, 4 and 5	Current Survey Trap Type 1 and 2	Oregon Survey
Mean Length	82.6	86.1	94.1
Standard Deviation	14.6	11	10.7
Minimum	47	55	67
Maximum	123	115	113
Number of Sample	234	394	145

Table 17. Sex composition of box crabs in aggregated locations

Locations	Number of Male	Number of Female	% of Male	95% confidence interval
1	386	244	61.3	57.3-63.1
2	136	80	63.0	56.1-69.3
6	178	136	56.7	51-62.2
7	96	56	63.2	54.9-70.7
8	160	67	70.5	64-76.2

Table 18. Percentage of injuries

Sex	Total Number	Deformed Shell	Hole in the shell	Torn Telson	Regenerated Legs/Claws	Multiple Injuries	Total Injuries	% of injury
Male	1096	5	4	1	5	2	17	1.55
Female	628	1	1		1		3	0.48

Table 19. Percentage and size of new and old shells

Sex		Number	%	Mean Length	Standard Deviation
Male	New Shell	784	71.5	97.79	19.63
	Old Shell	312	28.5	112.99	17.04
Female	New Shell	361	57.5	80.1	12.17
	Old Shell	267	42.5	91.18	9.93

New Shell includes new hard, new hardening and new soft
Old Shell includes old shell and real old shell

Table 20. Size and shell composition of females with different egg colors

Egg Color	Number	Mean Length	Standard Deviation	% of new shell	% of old shell
No Eggs	143	73.16	10.48	86.0	14.0
yellow	13	80	6.99	69.2	30.8
orange	125	93.13	9.13	68.0	32.0
red	61	89.75	7.26	19.7	80.3
brown	133	93.46	8.01	7.5	92.5
black	9	93.44	5.96	0.0	100.0

Table 21. Proportion of egg bearing females at different size groups

Length Group (mm)	Number of females without eggs	Number of females with eggs	Percentage of females with eggs
45-54	10	0	0.0
55-64	13	0	0.0
65-74	54	5	8.5
75-84	55	58	51.3
85-94	7	155	95.7
95-104	3	91	96.8
105-114	1	28	96.6
115-124	0	4	100.0

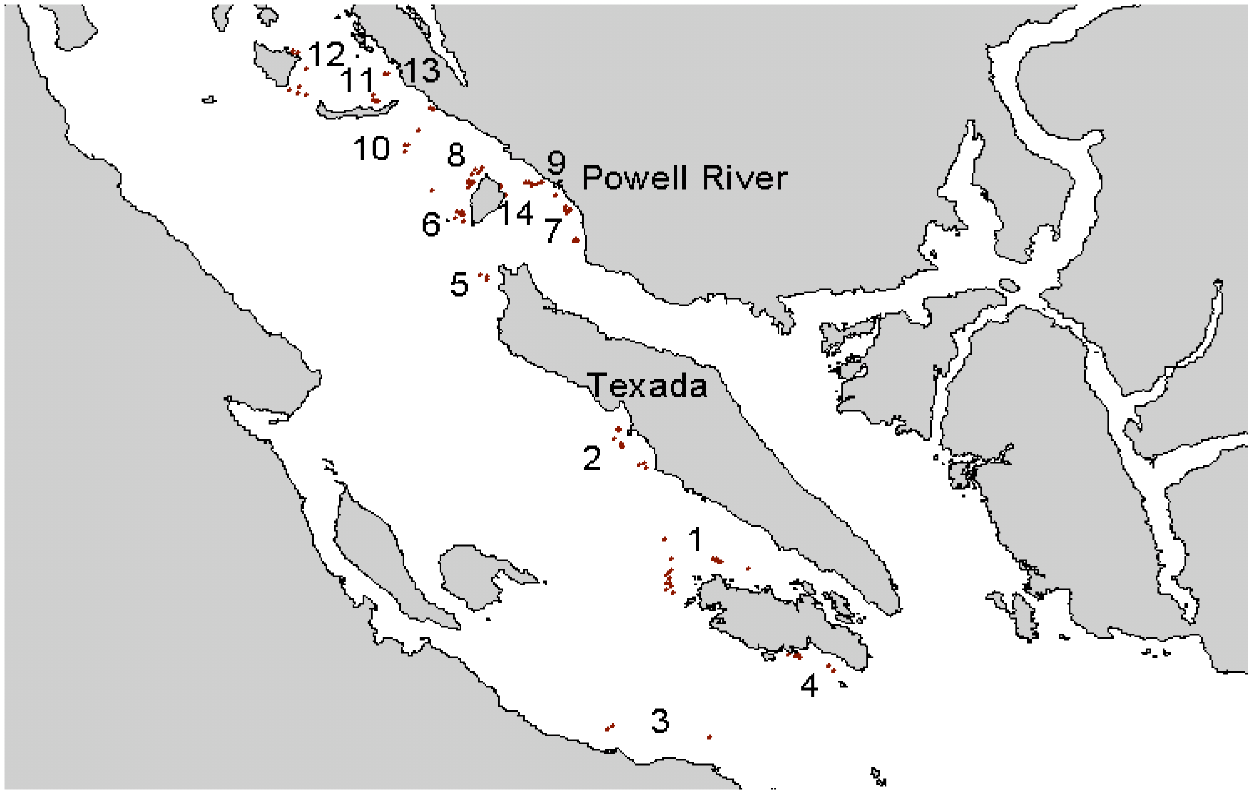

Fig. 1. Locations of Box Crab Survey

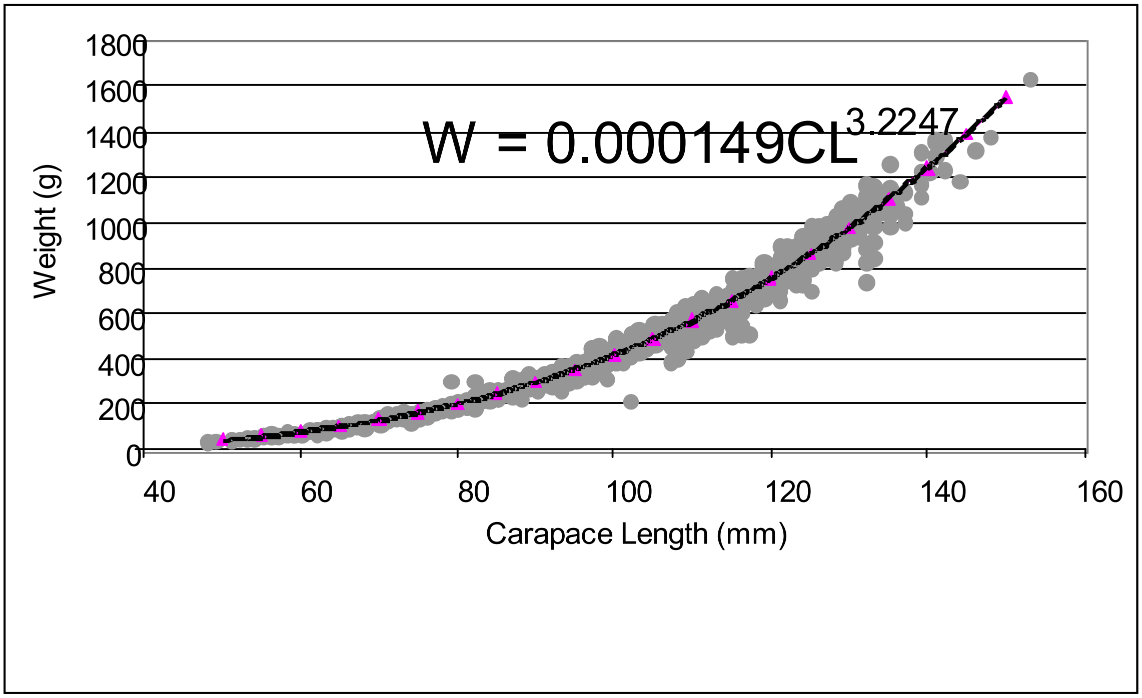

Fig. 2. Relationship between carapace length and weight for male box crabs

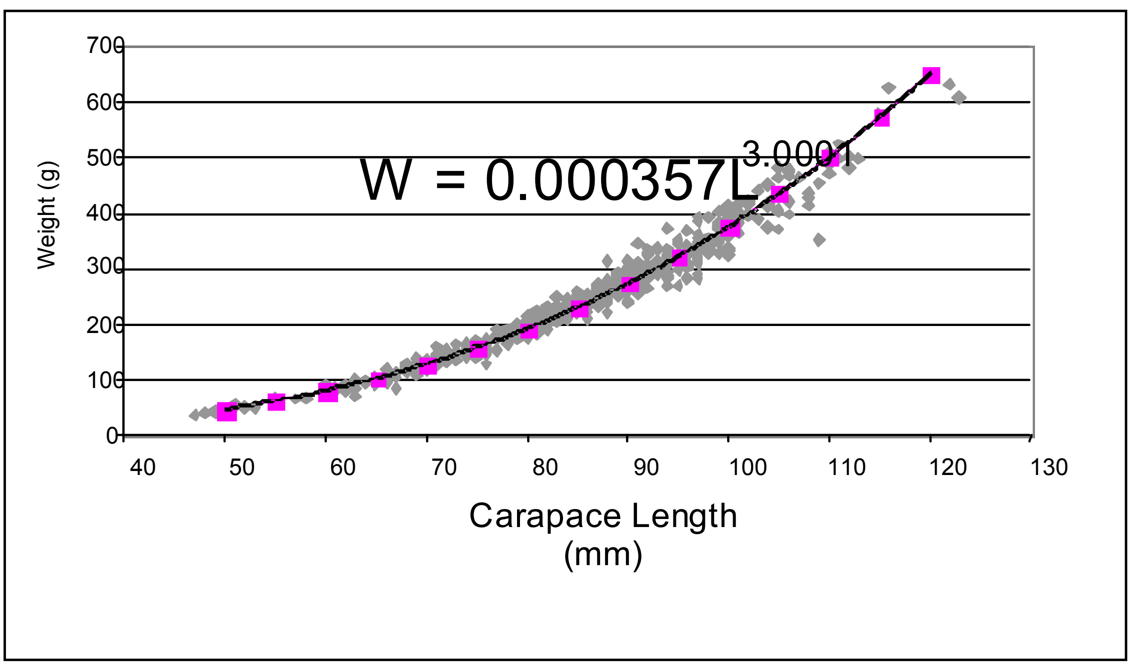

Fig. 3. Relationship between carapace length and weight for female box crabs

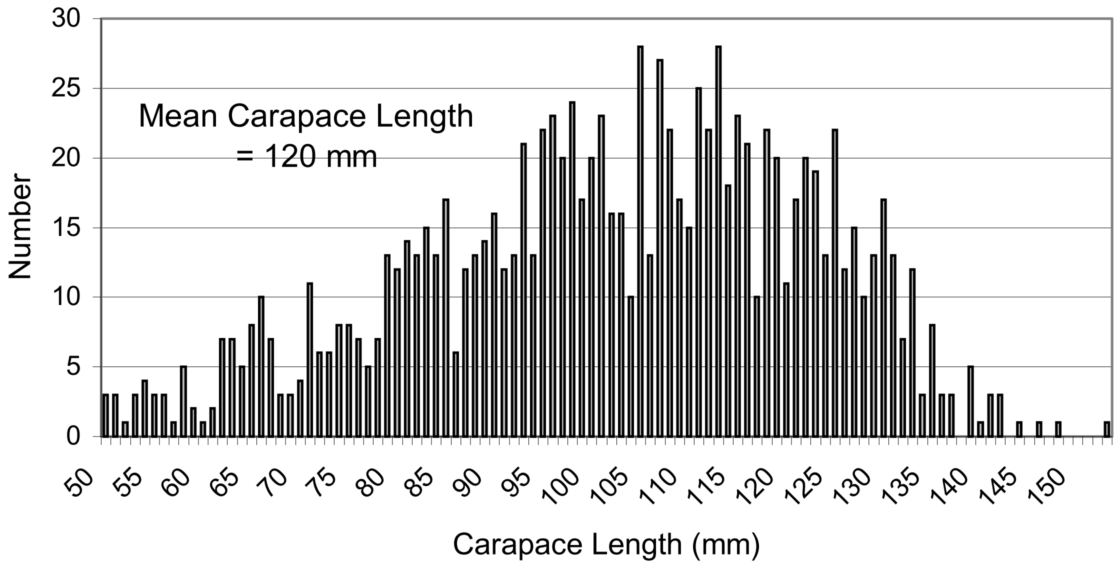

Fig. 4. Carapace Length Frequency Distribution for Male Box Crab

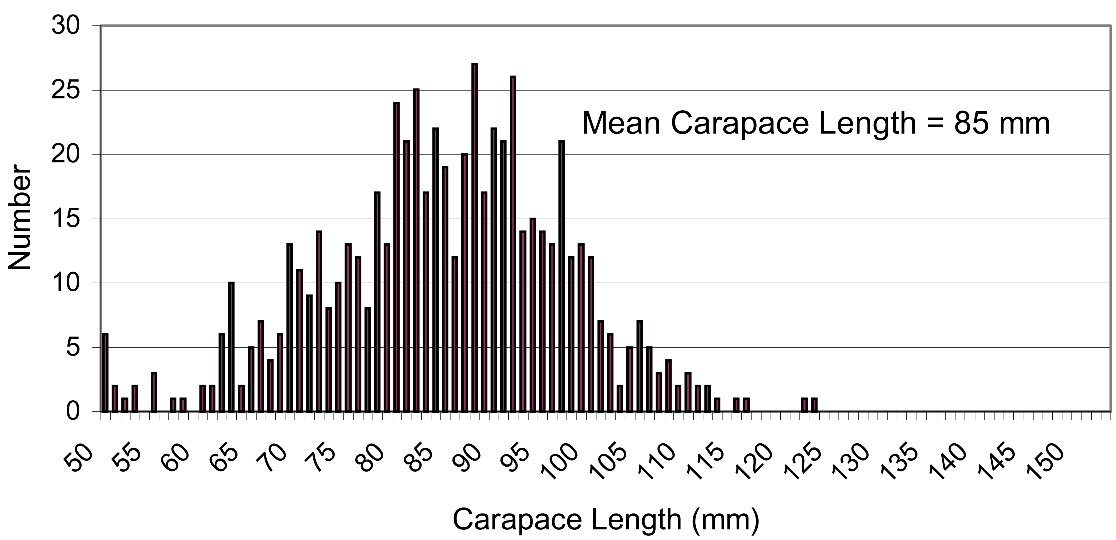

Fig. 5. Carapace Length Frequency Distribution for Female Box Crab

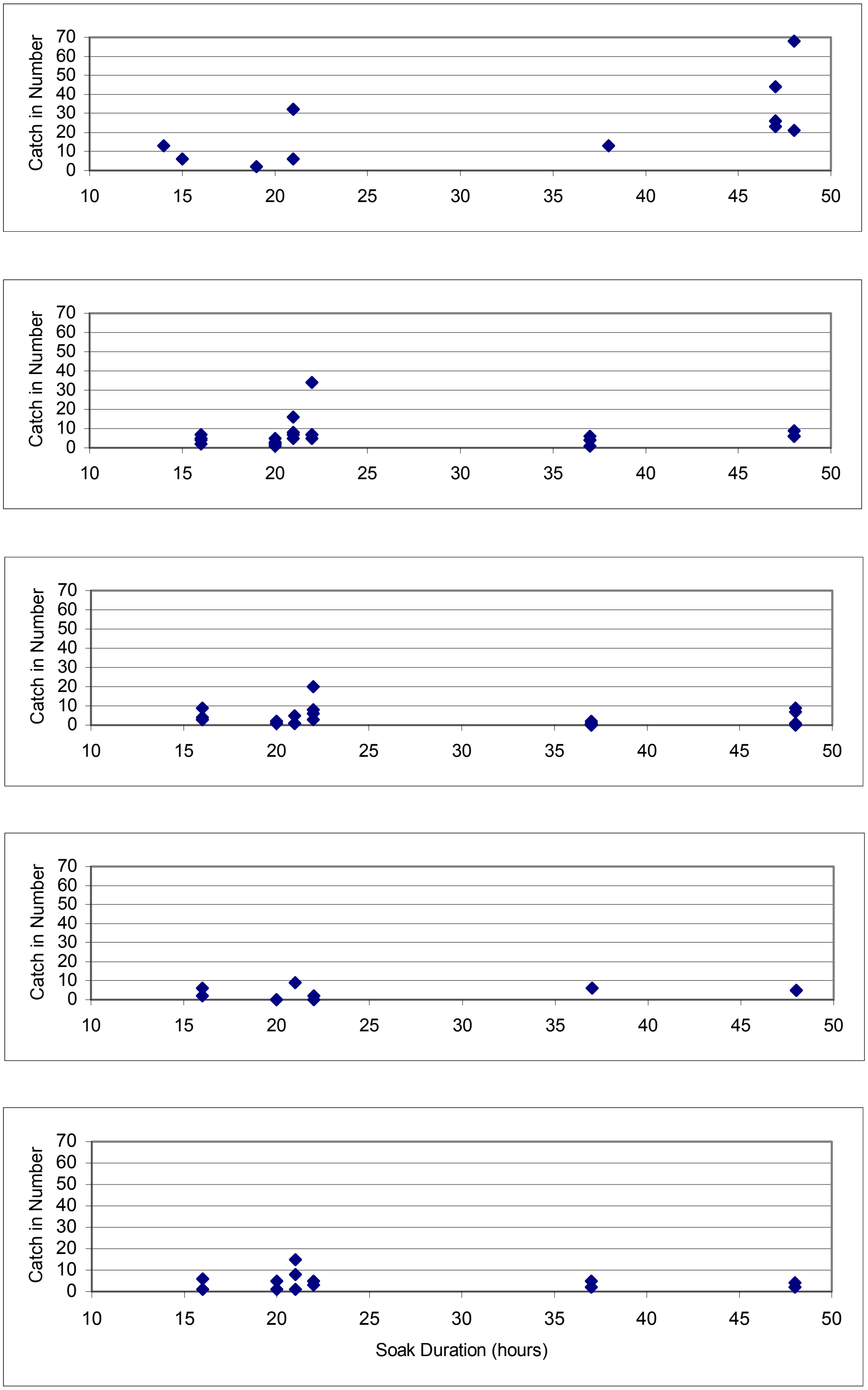

Fig. 6. Catch of box crabs for different soak duration by each trap type in location 1 (top - bottom panel: trap type 1 - 5)

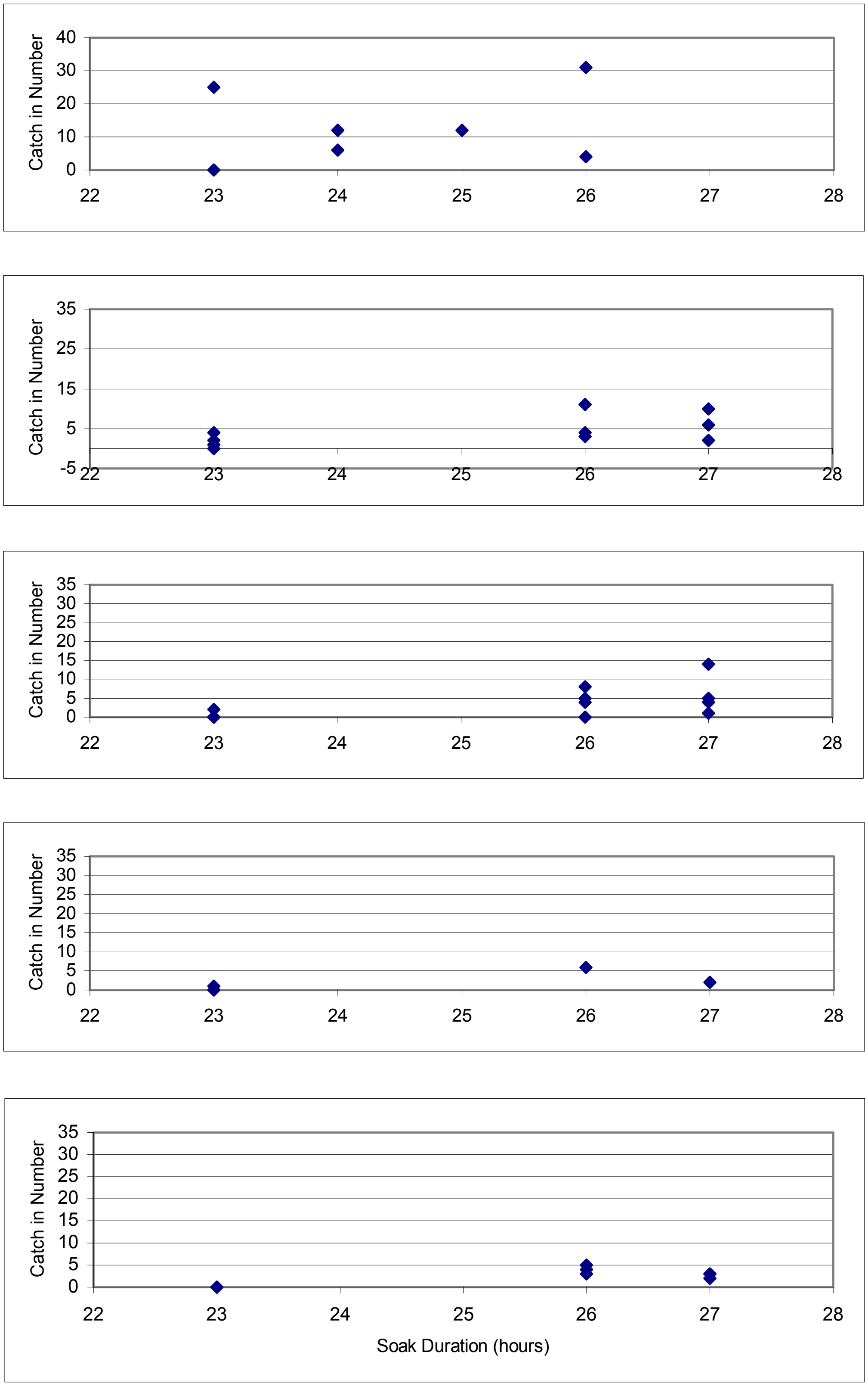

Fig. 7. Catch of box crabs for different soak duration by each trap type in location 2(top - bottom panel: trap type 1 - 5)

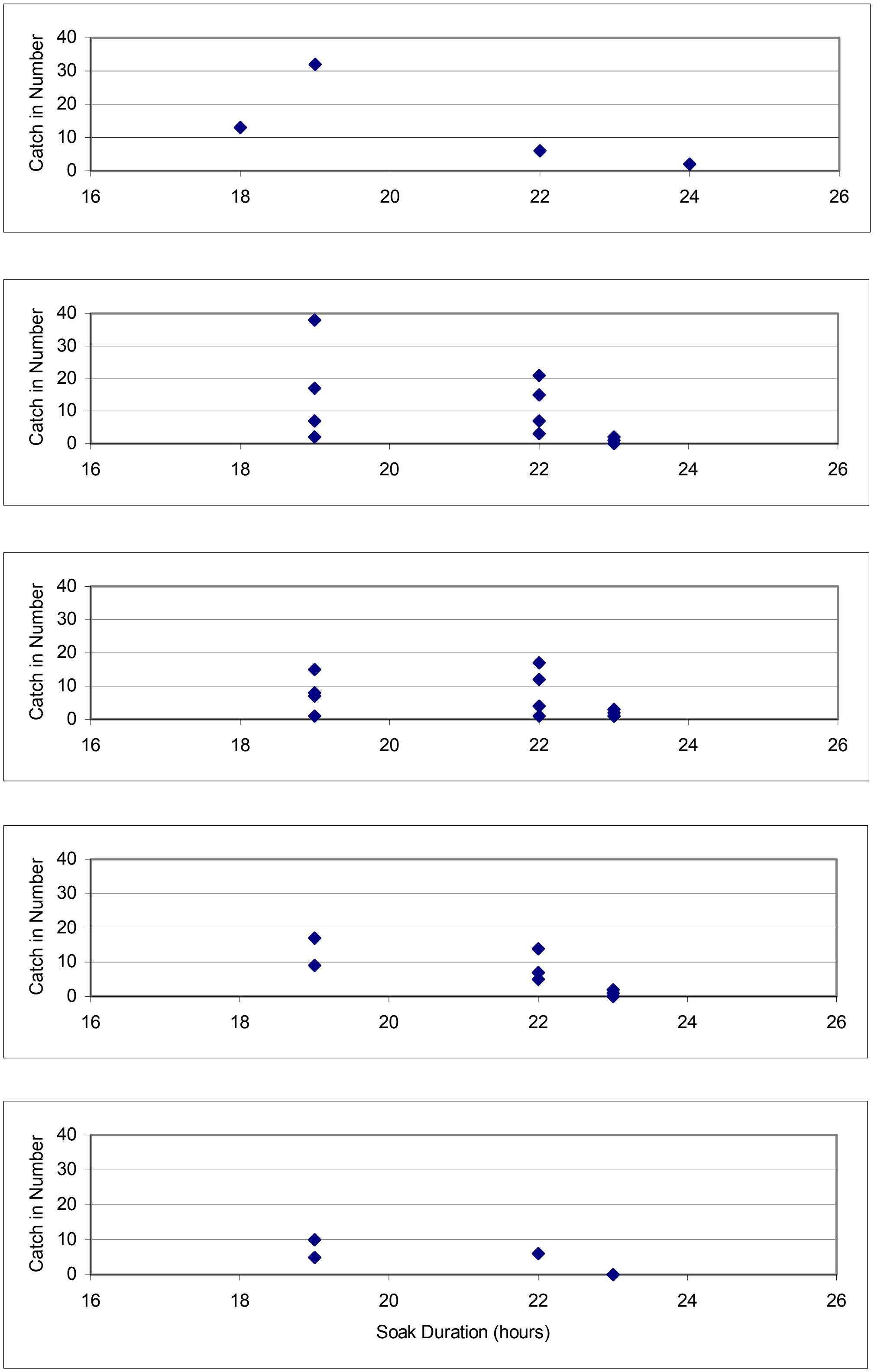

Fig. 8. Catch of box crabs for different soak duration by each trap type in location 6 (top - bottom panel: trap type 1 - 5)

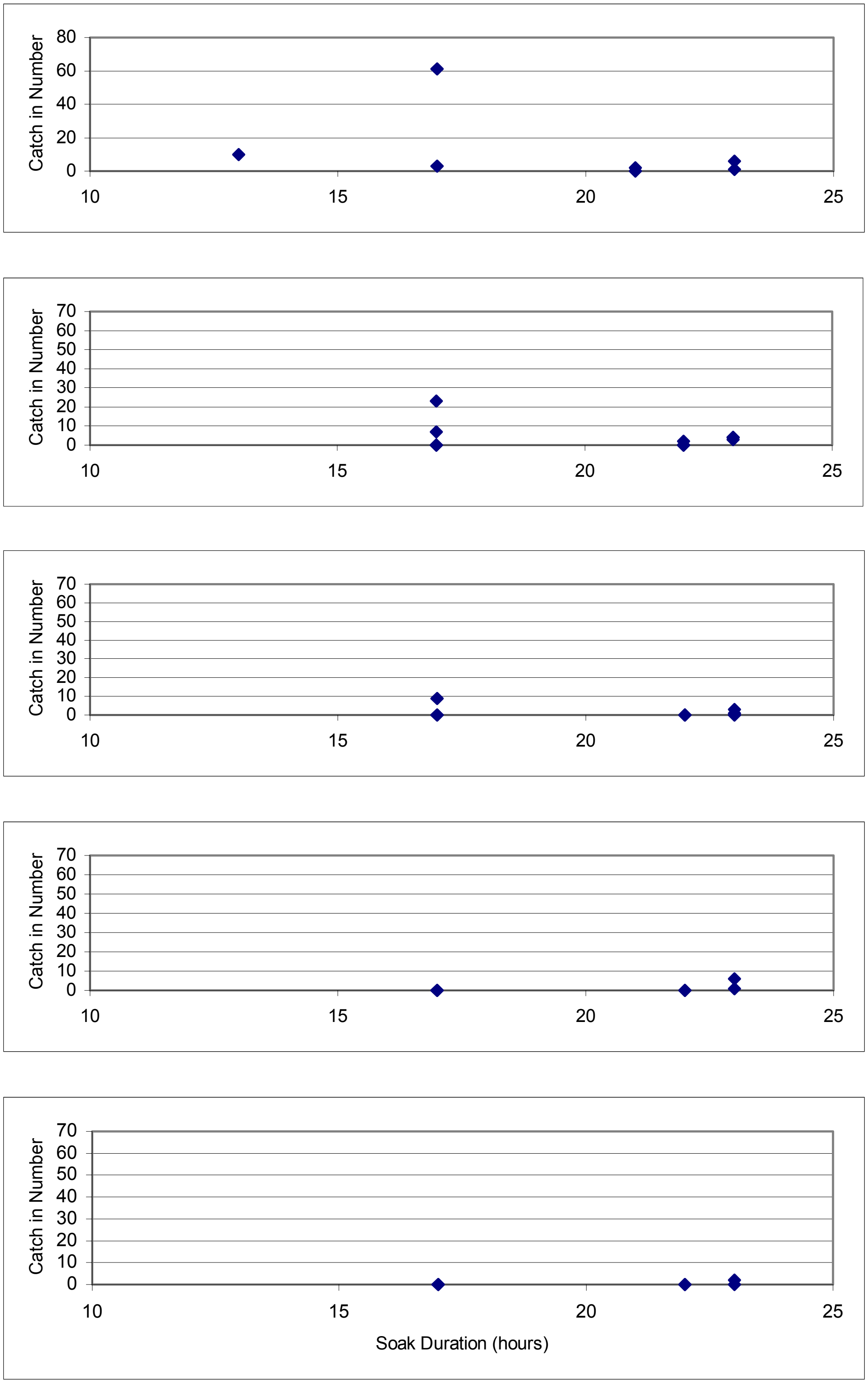

Fig. 9. Catch of box crabs for different soak duration by each trap type in location 7 (top - bottom panel: trap type 1 - 5)

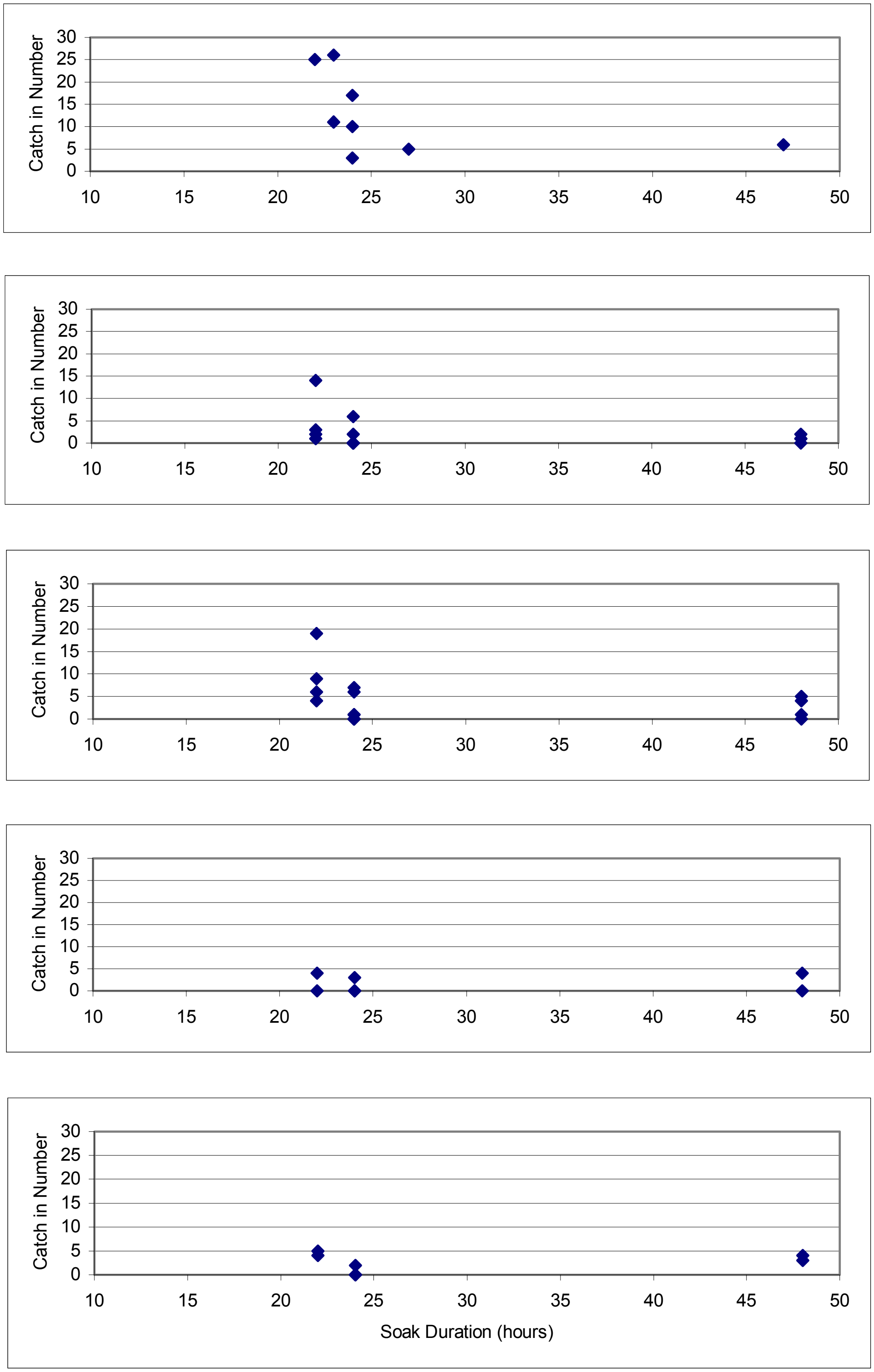

Fig. 10. Catch of box crabs for different soak duration by each trap type in location 8 (top - bottom panel: trap type 1 - 5)

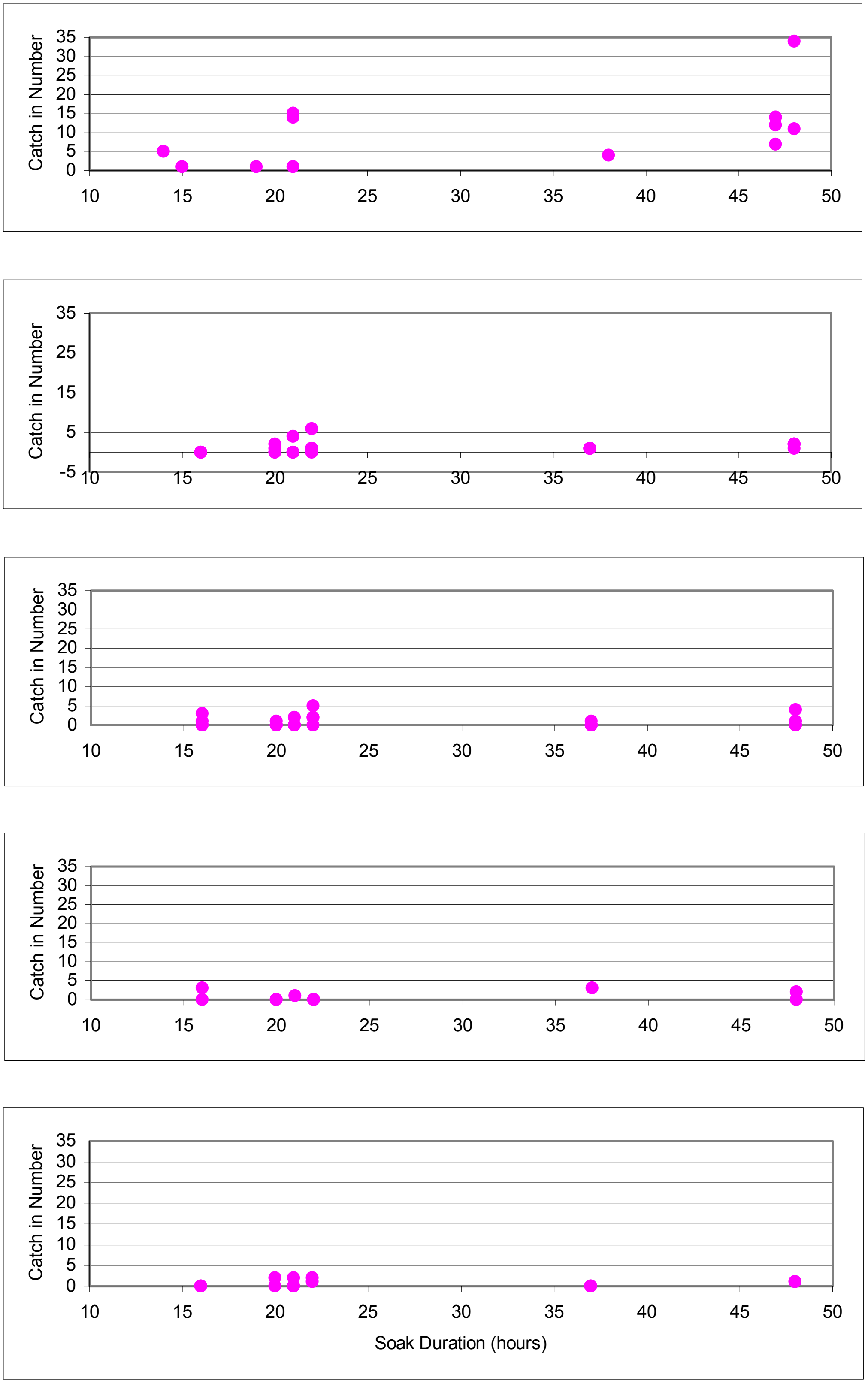

Fig. 11. Catch of large male box crabs for different soak duration by each trap type in Location 1(top - bottom panel: trap type 1-5)

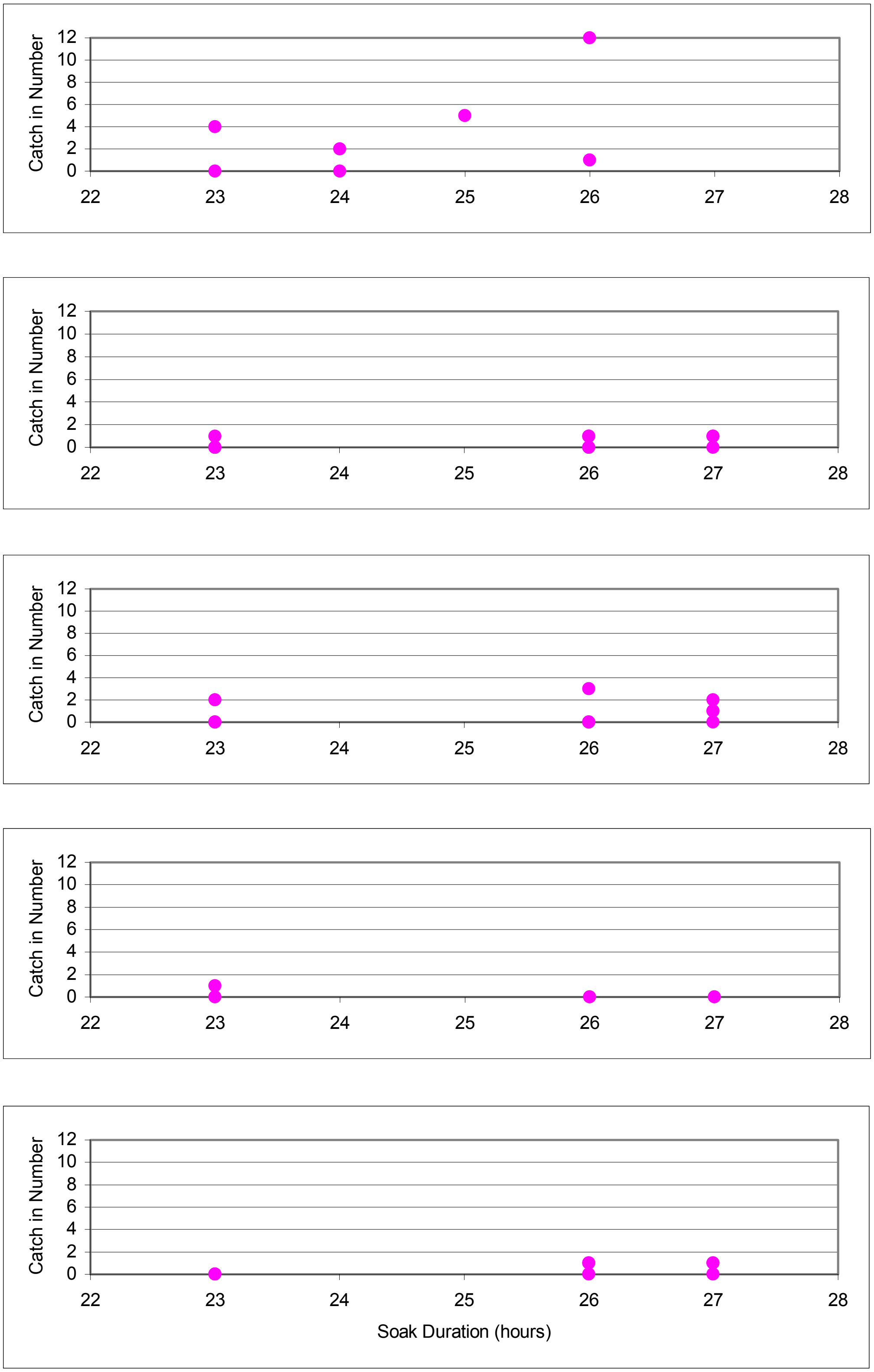

Fig. 12. Catch of large male box crabs for different soak duration by each trap type in Location 2 (top - bottom panel: trap type 1 - 5)

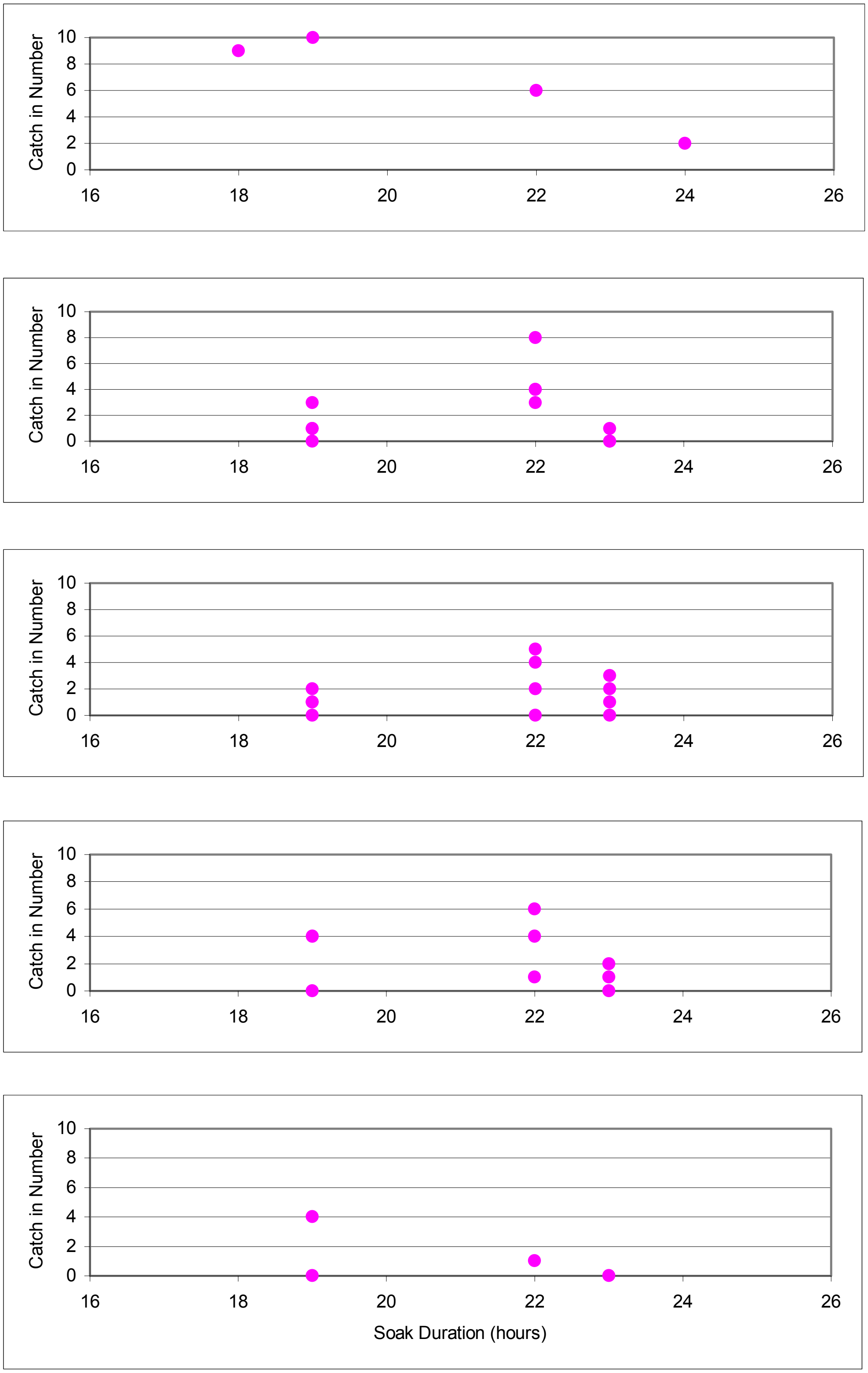

Fig. 13. Catch of large male box crabs for different soak duration by each trap type in Location 6 (top - bottom panel: trap type 1 - 5)

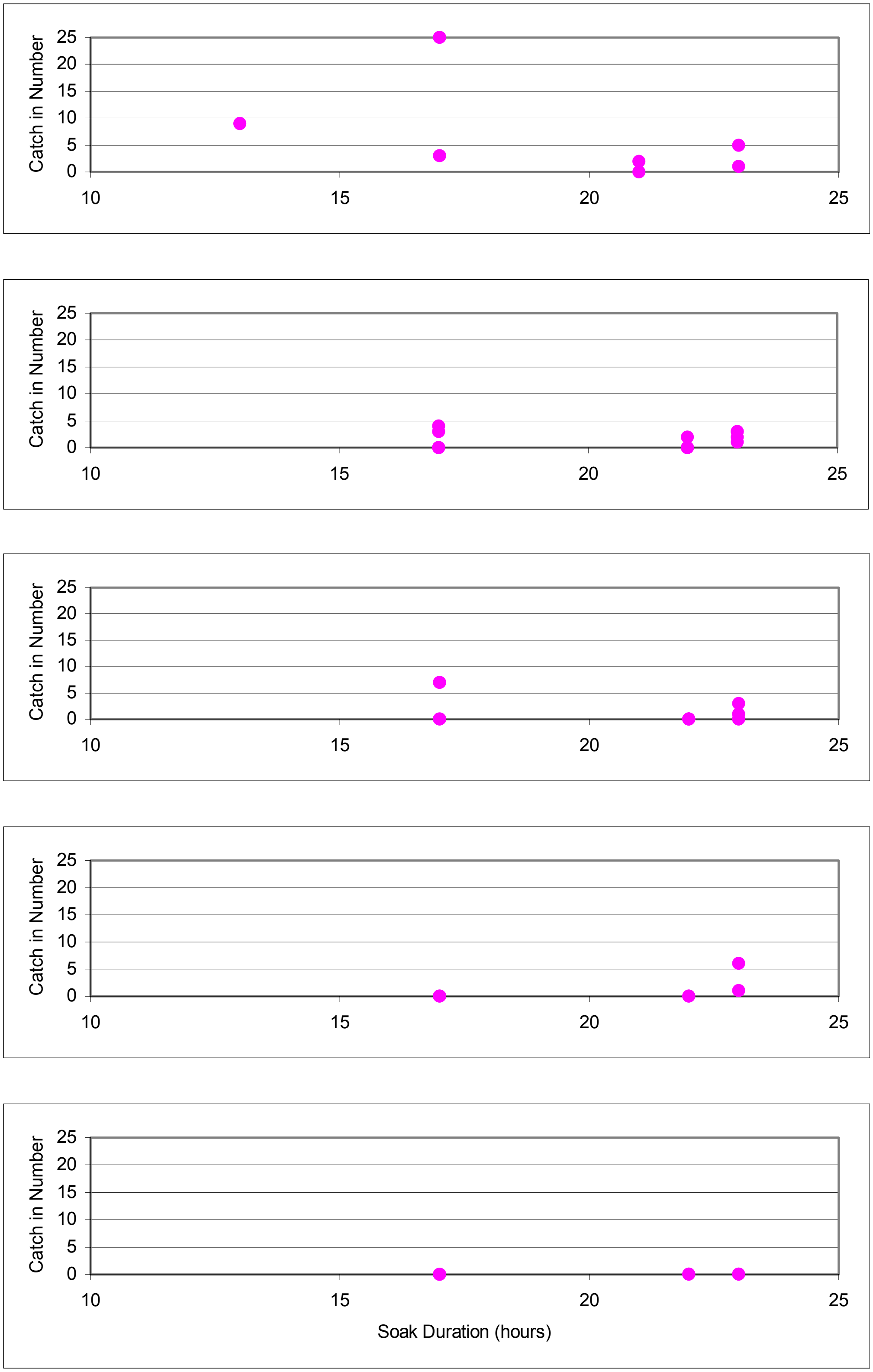

Fig. 14. Catch of large male box crabs for different soak duration by each trap type in Location 7 (top - bottom panel: trap type 1 - 5)

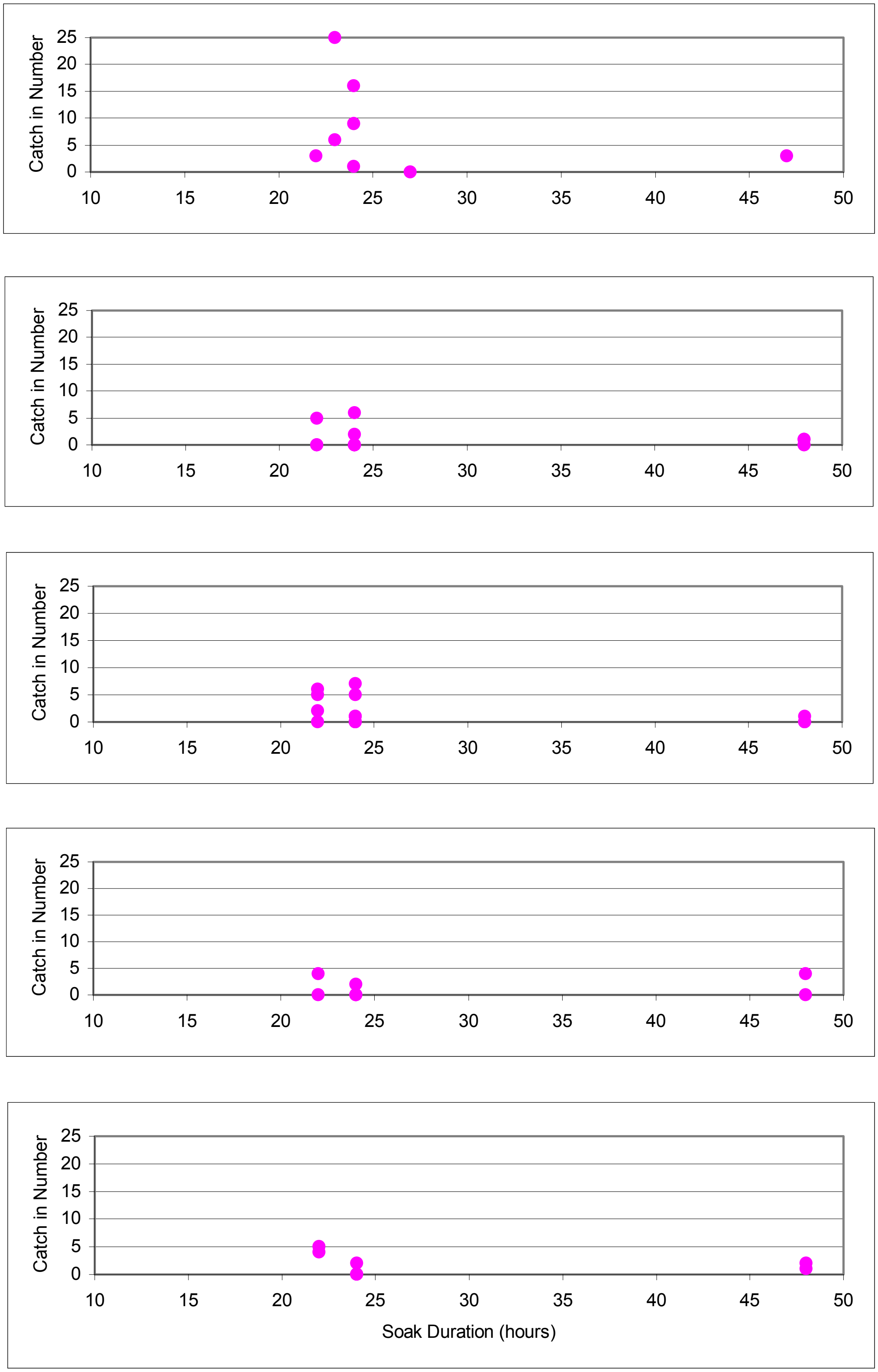

Fig. 15. Catch of large male box crabs for different soak duration by each trap type in Location 8 (top - bottom panel: trap type 1 - 5)

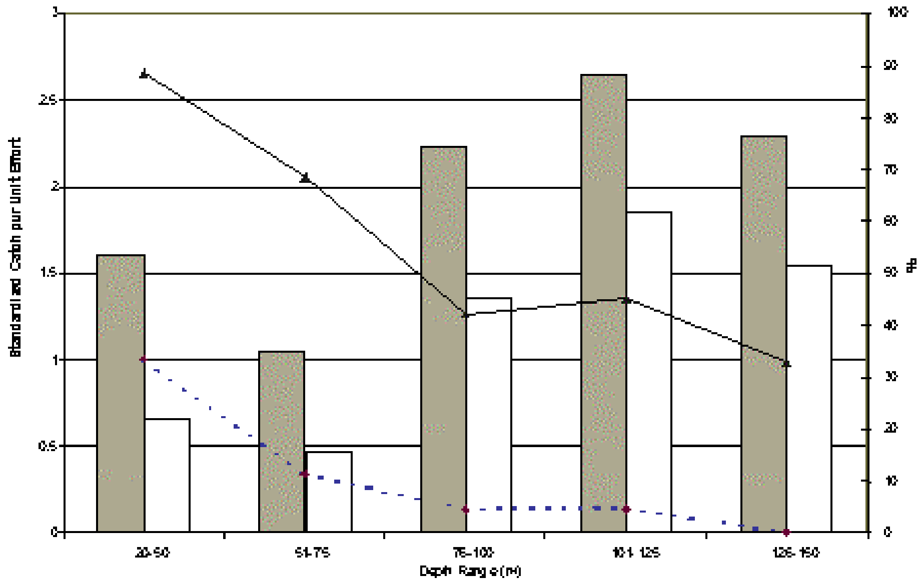

Figure 16: Composition of box crab size at different depth ranges

PSARC INVERTEBRATE SUBCOMMITTEE

Request for Working Paper – Brown Box Crab
Phase 1 Trap Evaluation Study in British Columbia

Date Submitted: April 2001

Individual or group requesting advice:
(Fisheries Manager/Biologist, Science, SWG, PSARC, Industry, Other stakeholder etc.)
B.Adkins, Shellfish Co-ordinator, FM; DFO/BCFish - Seafood Diversification Committee, and proposal from Sointula Box Crab and Whelk Association

Proposed PSARC Presentation Date:
(outline any timing concerns for the provision of advice)
Next WP review date - Nov 2001

Subject of Paper (title if developed): Brown Box Crab (*Lopholithodes foraminatus)* Phase 1 Trap Evaluation Study in British Columbia.

Lead Author(s): Ziyang Zhang
Fisheries Management Author/Reviewer: Dan Clark

Rational for request:
(What is the issue, what will it address, importance, etc.)
An unsolicited literature review and proposal for experimental fishing for information gathering was supported by Fisheries Renewal BC.

A Phase 0 literature and data review suggested that there was little information on the biology of brown box crabs. Phase 1 field studies were suggested to define some of the missing biological information using standard techniques used in other crab fisheries. These studies were to provide some of the missing information on box crab and determine a trap configuration that could be used in a distributional survey.

A Request For Proposal was advertised to conduct Phase 1 distributional surveys and collect biological information. A proposal to conduct a trap test and to collect data on the catch was accepted. Ten days of trap fishing with five trap designs were conducted, biological samples and data collected.

The relative success of five trap types and biological information needs to be analysed to define field techniques for investigating the distribution and population of this species. Information gaps for further investigation need to be defined. Potential management frameworks for commercial exploitation need to be developed.

Stakeholders Affected: An industry association has been formed (Sointula Box Crab and Whelk Association), First Nations, Coastal Communities

How Advice May Impact the Development of A Fishing Plan:

Advice will help define field techniques for a distributional survey and suggestions for an experimental/adaptive management plan.

Question(s) to be addressed in the Working Paper:

(To be developed by initiator)

What information on the parameters that affect the trap catch success for brown box crabs (bait, soak time, depth, substrate, current) were provided by this study?

What trap design (from the five designs tested) would be best to use in a distributional survey?

What information was contributed on box crab biology by the trap test study?

What information gaps on the biology of brown box crabs still need to be addressed?

Can the data from this study provide any advice on designing and monitoring experimental studies to address information gaps, and the potential for a commercial fishery?

Objective of Working Paper:

(To be developed by FM & StAD for internal papers)

Identify trap design and assessment procedures and an accompanying experimental studies that will provide managers with the necessary information on stocks and biology of Brown Box Crab (*Lopholithodes foraminatus)* to develop management plans that will lead towards and ensure long term sustainable harvests.

Timing Issues Related to when Advice in Necessary

Advice is necessary to respond to proposals to continue investigation into this species.

Studies will be funded from sources outside the department or from sale of catch.

The potential for a market has not been investigated.