The Use of Underwater Metal Detectors to Recover Outplants of the Mobile Marine Gastropod *Strombus gigas* L.

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ABSTRACT

Traditional techniques for recapturing hatchery-reared juvenile queen conch used in stocking programs have typically relied on researchers visually locating the outplants. This made recovering juvenile queen conch after release difficult and labor intensive because of their cryptic behavior. We present a low-cost method of recapture in which underwater metal detectors are used to locate tagged individuals. We compared recapture efficiencies of this method with those of the traditional, visual location method. Hatchery-reared juvenile conch (7.4 cm siphonal length) were tagged by securing a numbered aluminum tag around the spire and were distributed haphazardly within a 10 m x 10 m grid in an established conch nursery. The outplants were allowed 24 hours to disperse. Subsequently, the plot was surveyed simultaneously by a pair of divers. One diver searched visually; the other used a metal detector. Significantly more conch were located with the metal detector than were found visually (n = 2, $X^2 = 28.5629$, d.f. = 1, $p < 0.0001$). Overall, 93.9% of the outplants were located with the metal detector, whereas 28% were located visually. Based on these results, we conclude that metal detectors provide a significant improvement over the traditional method of locating small queen conch used in recapture studies.

KEY WORDS: Metal detector, queen conch, *Strombus gigas,* stocking, survey, tag-recapture

INTRODUCTION

Recapture surveys of hatchery-reared outplants are required before the efficacy of a stocking program can be evaluated. Queen conch are especially difficult to recapture after release because at the approximate size (7 cm) recommended for release (Jory and Iversen, 1988; Dalton, 1994; Stoner and Davis, 1994), they are often buried. Traditional studies have relied on exhaustive, labor intensive visual surveys to recover tagged individuals. We describe here a low-cost method of locating tagged individual with underwater metal detectors as an alternative to the visual location method.

MATERIALS AND METHODS

We compared recapture efficiencies of tagged conch located with a metal detector with those of conch located visually. A total of 16 hatchery-reared juvenile conch (μm = 7.4 cm SL, std = 0.3 cm) were distributed haphazardly within a 10 m x 10 m grid in an established conch nursery. The habitat consisted of moderately dense (64.1 g/m^2) live seagrass (*Thallassia testudinum* and *Syringodium filiforme*) in moderate density and, typically, coralline sand having a mean grain size of 250 μm to 2 mm.

We tagged all individuals by securing a numbered, aluminum tag (2 cm x 0.5 cm) around the spire with 20 - gauge monel wire using a method adapted from Glazer and Berg (1994) (Figure 1). The tags were dark brown and not readily visible. To reduce galvanic processes, the wire was inserted through a plastic sleeve.

Twenty-four hours after release, the plot was surveyed simultaneously by a pair of divers. Two tape measures were affixed to the bottom along parallel sides of the plot. A tape measure perpendicular to the other two bisected the plot. Search transects were conducted within one meter of either side of the perpendicular tape. One diver searched visually on one side of the tape while the other searched the adjacent side of the tape using the metal detector. Each diver was experienced in conch surveys. The diver searching visually also ran gloved hands through the seagrass and into the sediment. Divers swam adjacent to each other (Figure 2), with the diver using the metal detector controlling the search time. This effectively standardized the effort. After recording the tag number, divers immediately replaced all conch in the position as when they were found. Upon finishing the transect, the divers switched sides and the process was repeated. The perpendicular tape was then moved 2 m to the next position and the surveys were repeated until the entire plot was surveyed. Divers repeated the process by searching transects oriented 90° to those of the first trial in order to reduce possible bias associated with sampling identical transects. The divers did not exchange tasks for the second trial.

RESULTS

Each of the two trials was completed in approximately 0.75 hr. Significantly more conch were located with the metal detector than the were located visually ($n = 2$, $X^2 = 28.5629$, d.f. = 1, $p < 0.0001$). In both trials the metal detector located 15 of 16 outplants (93.9%). Four of 16 juvenile conch were visually located in one trial and 5 of 16 were visually located in the other yielding a pooled 28.1% overall recovery.

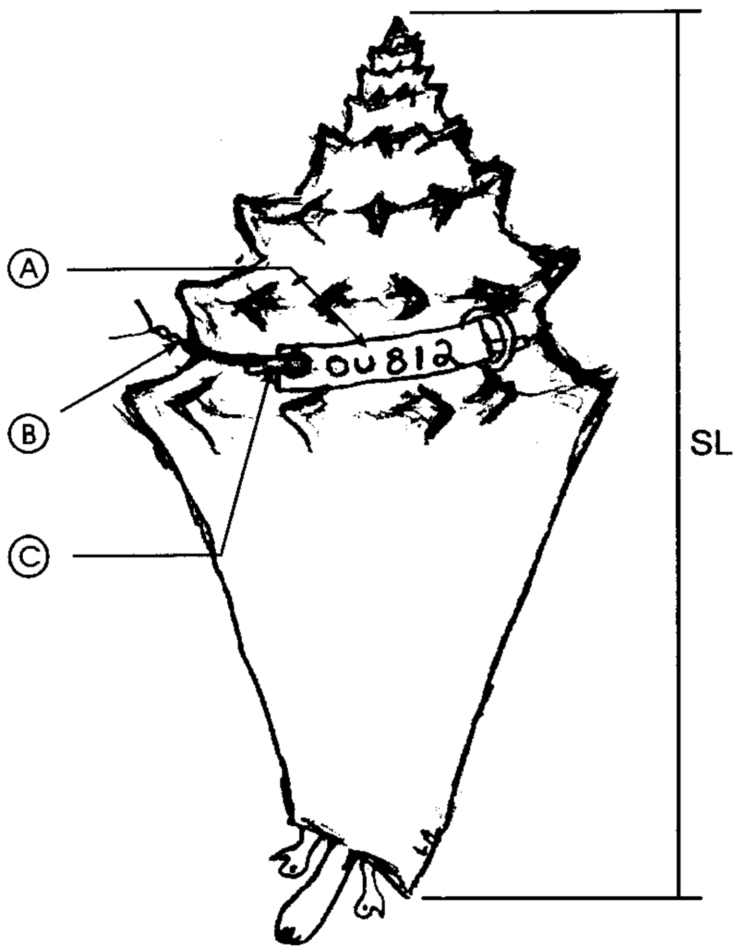

Figure 1. Tagged juvenile queen conch showing the numbered, aluminum tag (A), monel wire (B) and plastic sleeve (C). SL indicates siphonal length.

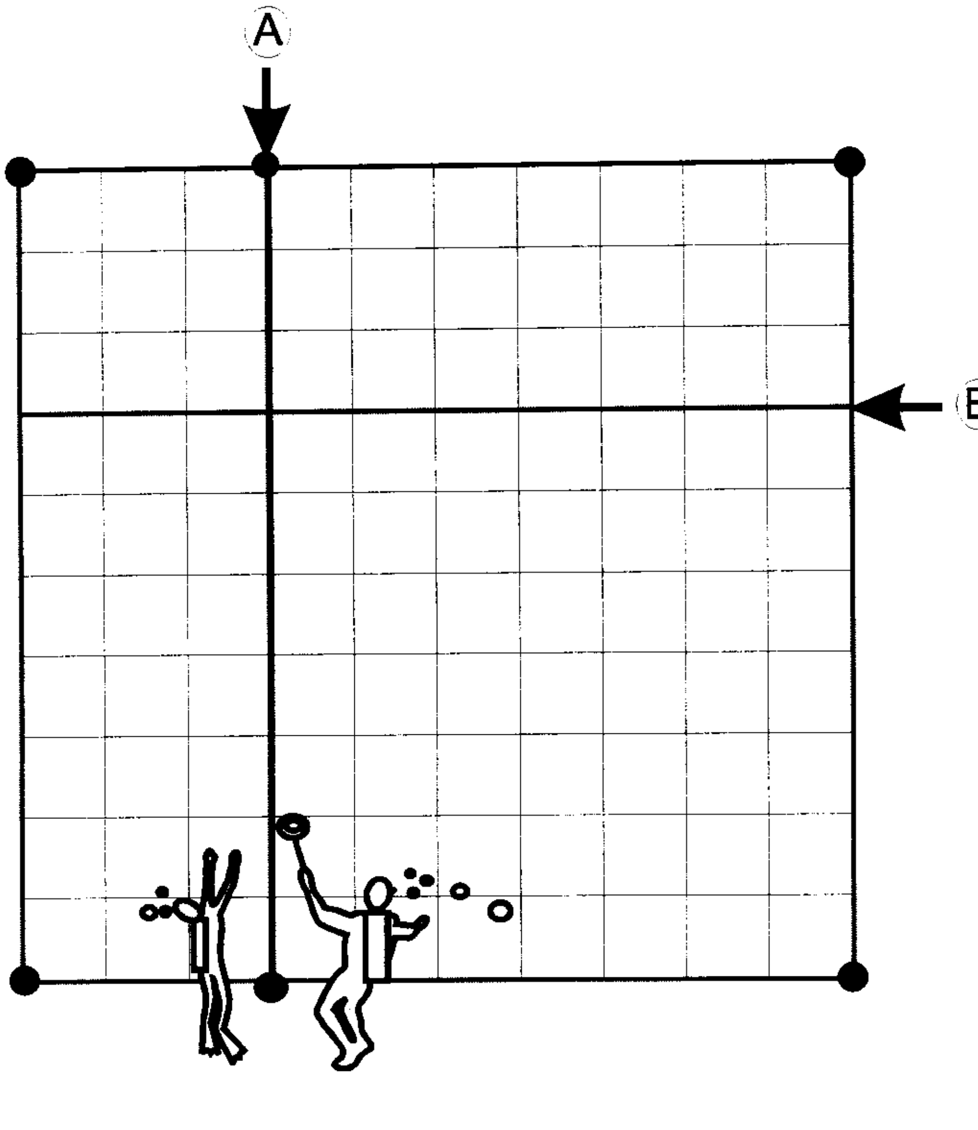

Figure 2. Surveys of the queen conch release plot with paired divers. Upon completing the north-south survey (1), the divers replicated the survey in an east-west direction (2).

DISCUSSION

Previous recapture studies of queen conch outplants relied on visual location for sampling and have assumed that intensive sampling resulted in recovery of all individuals in the survey area (Appeldoorn and Ballantine, 1983; Appeldoorn, 1985; Stoner and Davis, 1994). To effectively sample an entire plot by sight requires a tremendous commitment in labor. Even then, it is unlikely that all buried conch will be found. In our study the metal detectors were able to locate conch buried 6 cm in the substrate.

The use of metal detectors can dramatically increase sampling efficiency. An entire plot can be searched in a relatively short period of time with little disturbance to the substrate. Our surveys were completed in approximately 0.75 hour. By contrast, our previous studies, which relied on exhaustive visual surveying, required more than twice the time to survey the same area, and they seriously disturbed the benthos. Interestingly, in each trial in which the metal detectors were used, one individual was not found that was found in the other trial: metal detectors are not foolproof and cannot be expected to recover 100% of the outplants.

It is likely that more conch would have been recovered had the diver visually censusing technique been permitted more time to sample. In the context of efficiency, the effort would have increased which would have decreased the overall catch per unit effort associated with visual surveys.

In some cases, the ability to visually locate conch may have been enhanced because during the previous survey, the metal detector or diver could have disturbed the conch or surrounding sediment. In these instances, however, the resulting bias would effectively produce a type II error resulting in no differences detected where actual differences existed. Indeed, if this were the case, even fewer conch would be expected to be located visually in undisturbed plots.

The selection of tag material is critical to efficient detection. We evaluated many configurations of tags before we finalized our selection. Ideally, the metal wire used to affix the tag to the spire would be the same material as the tag because tags that are made of different metals have a decreased tag life the associated with galvanic processes arising from the electrical potential between the two materials. Although aluminum tags produced the best signal, aluminum wire was too soft and broke when cinched about the spire. Stainless and monel tags were undetectable by the metal detector.

Glazer and Berg (1994) reported probability of tag-loss using monel wire and monel tags after six months to be $p = 0.001$. It is likely that the method presented in this paper has lower tag-retention due to the galvanic processes that still occur albeit to a much lesser extent than if the metals are in direct contact with each other (Glazer, personal observation).

Cost was a primary consideration when we selected the materials for this study. Metal detectors tend to be quite expensive and must be carefully evaluated for their sensitivity. After discussions with manufacturer's representatives, we selected a model that was coincidentally the least expensive detector we found ($500 U.S., Surfmaster P.I., Whites Electronics, Sweet Home, Oregon, 503-367-2968). Although more expensive models may have additional features and higher resolution, we found this detector to be wholly adequate for our purposes. The detector operates on 8 AA batteries.

We have incorporated this recapture method into our ongoing research program in which local volunteers participate in recapture surveys to evaluate outplant survival. The simple design of the detector (there are only two controls for sensitive discrimination between metals) and the obvious audible 'clicking' signal when aluminum is present make it easy for volunteers to use. We expect bias among surveyors using this technique to be minimal relative to that associated with visual surveys.

Based on these results, we conclude that metal detectors provide a significant improvement over the visual location method in recapture studies of slow-moving benthic marine gastropods such as the queen conch. However, overall cost must be evaluated, and, in the cases where labor may be inexpensive and readily available, the visual surveys may be more cost-effective. In other instances, incorporating metal detectors into recapture surveys may reduce the overall expenditures associated with surveying while decreasing sampling biases resulting from incomplete recaptures.

ACKNOWLEDGMENTS

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