A novel technique for tagging the long-spined sea urchin Diadema antillarum

Fernando Tuya, José Antonio Martín & Ángel Luque

We describe a new protocol for tagging the long-spined sea urchin Diadema antillarum to study the daily activity patterns of this echinoid. The technique consists of the in situ introduction of a fishing hook into the periproctal membrane of individual D. antillarum with the help of tweezers, thus allowing the individual identification of tagged urchins. Preliminary tests displayed the effectiveness of this method.

Keywords: Sea urchins; Diadema antillarum; tagging; movement; Canary Islands.
an urchin were difficult to remove by simply pulling on the tag. The tagging protocol usually took less than 20 s per individual.

Preliminary tests were carried out at shallow rocky reefs to check the efficacy of the technique, as well as to assess the possible damage incurred by the tagging procedure. The distances travelled by tagged individuals were monitored and compared with non-tagged individuals by observers equipped with free-diving equipment, waterproof paper and metric tapes, for about 4–5 h per day. Non-tagged urchins were identified by their test diameters using callipers (James 2000). These comparisons were repeated three times (days) in an intertidal pool at Arinaga (Gran Canaria Island). Adult sea urchins (size class III 3.5–5.5 cm test diameter and size class IV > 5.5 cm; according to Casafías & al. 1998) were randomly selected each time, to avoid problems of non-independence and pseudoreplication of data (sensu Hurlbert 1984). The significance of the difference between mean individual distances moved per day between tagged and non-tagged sea urchins was calculated by means of the non-parametric Mann–Whitney U statistic (James 2000).

The percentage of tag retention per test ranged between 80 and 90% (Table 1). No significant differences in terms of movement of tagged and non-tagged individuals were obtained for any of the 3 days (Table 1). We therefore pooled the data from the three tests and calculated an overall pooled data Mann–Whitney U statistic. The probability level (p value, Table 1) of this test was not low enough to reject the null hypothesis, indicating therefore the non-significance of the comparison between the movement of tagged and non-tagged sea urchins. We calculated the power of this test using the Pass 6.0 package (Hintze 1996), taking into account that the power analysis for a non-parametric test (Mann–Whitney U) has to be conducted by adjusting the result obtained for the corresponding parametric test (t-test) (Hintze 1996). The low power detected (0.31 at z = 0.05) was probably a function of (1) the low number of non-tagged sea urchins that could be followed, as it is logistically difficult to follow non-tagged urchins in the field (Dance 1987) and (2) the high variability associated with the distances travelled by sea urchins (Dance 1987; James 2000). In addition, we determined how many...
Table 1. Percentage of tag retention and mean (± standard deviation) travelled distances (cm) by tagged and non-tagged *Diadema antillarum* for each test (day) and for pooled untransformed data. The Mann–Whitney U statistic and the associated p value indicate no significant differences between tagged and non-tagged individuals.

<table>
<thead>
<tr>
<th></th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Pooled data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean ± SD</td>
<td>n</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Tagged</td>
<td>10</td>
<td>97.3 ± 26.09</td>
<td>10</td>
<td>88.65 ± 39.68</td>
</tr>
<tr>
<td>Non-tagged</td>
<td>5</td>
<td>111.81 ± 23.88</td>
<td>5</td>
<td>96.1 ± 25.65</td>
</tr>
<tr>
<td>Mann–Whitney U statistic</td>
<td>18.00</td>
<td>17.50</td>
<td>14.00</td>
<td>146.5</td>
</tr>
<tr>
<td>p value</td>
<td>0.39 NS</td>
<td>0.35 NS</td>
<td>0.73 NS</td>
<td>0.18 NS</td>
</tr>
<tr>
<td>% tag retention</td>
<td>80</td>
<td>90</td>
<td>87.5</td>
<td>85.83</td>
</tr>
</tbody>
</table>

SD – Standard deviation; NS – Not significant.

tagged sea urchins would have been required for the null hypothesis to be rejected at the $\alpha = 0.05$ level. A total of 662,296 tagged sea urchins would have been necessary to reject the null hypothesis; with an increase in power from 0.31 to 0.56. Consequently, the results from these statistical tests displayed evidence of an absence of alteration in movement due to tagging. Therefore, we assumed that the observations of tagged individuals were not confounded by the tagging protocol.

As Dance (1987) indicated, the effect of tagging on short-term echinoid activity is difficult to determine, as non-tagged individuals cannot easily be followed in the field during night hours. Although no flight reaction or podia movement was observed immediately after tagging, it is difficult to provide evidence of the possible damage caused by tagging on the behaviour of sea urchins, as considered in many tagging studies (Sinclair 1959; Gamble 1965; Shepherd & Boudrevesque 1979; Lewis 1980; Dance 1987).

The technique used in this paper is cheap, quick and easy for experienced SCUBA divers to perform. The procedure is carried out *in situ* and does not require the removal of sea urchins from their habitat, which is an important parameter when working with species of sea urchins that burrow (Neill 1987). It can, therefore, be effectively applied for marking multiple individuals to study short-term (daily) migrations of sea urchins. However, a potential problem that we have not yet evaluated, and which should be dealt with in future tagging experiments, is the possibility that inserted tags may act as an attractant to sea urchin predators such as fish.

At present there is considerable research activity regarding the ecology of *D. antillarum* populations along the Canarian Archipelago. The tagging technique presented in this paper is enabling us to carry out experiments to study the daily movements and the homing behaviour of this invertebrate species along the Canary Islands, in the framework of a research project concerning the rapid increase inurchin-grazed barrens along the Canaries (Casañas et al. 1998; Garrido et al. 2000).

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REFERENCES


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