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Investigating the effects of disturbed beaches on crustacean biota in Okinawa, Japan

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10 11 12 13 **Abstract**

14 Subtropical Okinawa Island is known for its high marine biodiversity, yet relatively little
15 work has been performed on examining the impacts of coastal development on its marine
16 ecosystems. In this study, we examined three sandy disturbed beaches (including two artificial
17 beaches) on three different sides of the island (artificial Ginowan Tropical Beach on the west
18 coast, artificial Azama San-san Beach on the east coast, public Odo John Man Beach on the
19 south coast) to investigate if differences exist in the environment and crustacean biota between
20 paired disturbed and natural beaches. We conducted seasonal surveys (n=4 surveys) by placing
21 quadrats at three paired locations (artificial/disturbed and natural beaches at each location, to
22 collect and record the diversity of infaunal crustacean (isopods and amphipods) taxa. Amphipods
23 and isopods are basal parts of the food chain and therefore many marine creatures' diets contain
24 them directly or indirectly, and they have been used in many studies as bioindicators. As well,
25 environmental parameters including sand grain size, water temperature, and seawater quality
26 (salinity, dissolved oxygen content, particulate organic matter, turbidity, conductivity, pH,
27 phosphate, nitrite, nitrate, ammonium levels) were obtained from each site during each survey.
28 The results showed that while water nutrients, sand composition, and water quality were very
29 similar between paired disturbed and natural beaches, disturbed beaches had significantly less
30 biodiversity. These results show that despite no obvious effects on water nutrients or quality,
31 disturbed and artificial beaches influence the infaunal crustacean biodiversity/community in the
32 classic manner of a disturbance. Furthermore, our results indicate that amphipods may be better
33 indicators of disturbance compared to isopods, as the numbers of isopods were too low to be
34 used in statistically robust analyses. With increasing tourism and corresponding development of
35 artificial beaches in Okinawa Island, it is clear more research needs to be done on this subject.

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37 **Key words:** Okinawa Island; biodiversity; disturbed beaches; marine ecosystem; amphipods;
38 isopods

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