Former Pit Mine Dive Parks

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Abstract

Flooded pit mines are attractive venues for divers to visit. An electronic search identified inland dive parks woldwide. Former pit mines rehabilitated as dive parks (n=157) were located in 13 countries at latitudes between 13° and 58°. The median surface area of the water was 6.6 ha and 90% of depths ranged between 9m and 70m. Water temperatures ranged from a median 7°C in winter to a median 24°C in summer. The median age of the dive parks was 21 years and the youngest opened in 2010. Dive parks appear to offer a popular form of pit mine rehabilitation.

Keywords: dive parks, scuba, mines rehabilitation, sustainability.

Introduction

Internationally the seasonality of offshore diving has stimulated the development of inland dive parks. In the United Kingdom (UK), for example, between 1992 and 1996, 238,501 divers paid for entry to Stoney Cove and the worse the weather offshore, the busier it is at "*the Cove*" (Hart, White, Conboy, Bodiwala, & Quinton, 1999). Indeed, artificial dive sites are promoted as environmentally sound alternative dive destinations, to reduce pressure on fragile reef systems (Treeck & Schuhmacher, 1998). Duration of involvement and number of dives experience have been found to be associated with diver's skill/behavior underwater (Ghazali, Wong Tong, Thinaranjeney, & Masoud, 2011) and inland dive parks are less vulnerable to damage from trainee divers learning buoyancy control than slow-growing coral reef systems. Diver training frequently accounts for a significant proportion of dive park use (pers. Comm., Stu Schooley, 17th June 2007) so the more training that moves from a fragile marine ecosystem to more robust inland dive parks then the better the net gain for the marine environment. In addition to reducing pressure on nearby marine ecosystems, with a dive park available diver training businesses advertise dive courses knowing they will be completed on schedule, which is important when a proportion of the customers are tourists with a limited time frame in which to complete their training. Though participation during winter is much lower than in summer, the ability to extend the dive season by utilising an inland dive park significantly adds to the annual turnover of a local dive industry. In some locations inland dive parks are even the preferred dive destination. In Johannesburg, for example, there were 30 dive businesses advertised in the 2008 business telephone directory and yet Johannesburg is located seven-hours by road from the nearest beach (Buzzacott 2009). Despite strong dive industry growth over four decades, a stable population of resident divers, large numbers of visiting divers annually and yet seasonally inhospitable conditions near to shore, Australia does not yet have an inland dive park.

The definition of a former pit-mine dive park used in this study was a flooded former pit-mine meeting either of the following criteria:

- fees were charged to dive in the water or
- man-made objects had been purpose built or placed underwater to attract divers

Desirable park criteria

In Australia there are many potential sites for an inland dive park. At last count there were 1800 disused mine sites in WA alone, many of them flooded by stream and/or spring (Johnson & Wright 2003). For example, former coal mine Stockton Lake near Collie has excellent underwater visibility and flooded tunnels kilometers long. Nearby Black Diamond Quarry is popular both for a stolen Holden Commodore car and the numerous long-necked turtles that now live in it. A number of factors need to be considered before establishing an inland dive park, not least of which the anticipated level of diver visitation. Factors relating to the popularity of a dive park may include: proximity to the customer base (nearest urban centre), on-site facilities (toilets, air fills, camping), underwater attractions (training platforms, fauna, objects), water suitability (depth, temperature, turbidity), and site specific hazards (altitude, overhead areas). How prevalent these factors are among existing inland dive parks is currently unknown and requires identifying before a feasibility study might rank potential dive park sites within any particular geographic area. This information may also be of use to other entities considering the rehabilitation of a pit mine into a dive park and to existing dive park managers.

Methods

Human Research Ethics Committee approval was granted by Edith Cowan University, a survey instrument was designed to collect data concerning any dive park's location, on-site facilities, physical characteristics, park uses, fees and access management. Internet search engines were used to identify scuba diving forums (n=9) and posts were made requesting the names and locations of inland scuba parks. Fifty-two parks were identified by members of those forums and a further 148 were identified by using the search terms "scuba dive park". Web-sites linked to each dive park were accessed and survey data entered into an Excel spreadsheet. One week after completing this phase duplicate data was re-obtained from the relevant internet sites for every 25th dive park (n=8). This data was re-checked against that initially obtained to estimate the reliability of data entry. Of the 840 data checked, 805 (95.8%) were found to have been entered identically.

An information sheet and a web-link to the online survey was e-mailed to 90 e-mail addresses linked to inland dive parks identified during the internet search. These included park owners, managers, associated dive clubs and/or local government. Ten of these e-mails (11%) were returned undelivered and of the remaining 80 e-mails, questionnaires were completed anonymously for twelve dive parks (15%). From the completed surveys, 318 data were checked against corresponding data obtained from the respective web-pages and 190 (60%) were found to have been obtained from the internet search.

Of the 200 dive parks, 93 were identified as former pit mines. A further 64 pit-mine dive parks were identified using the search terms "dive and park" and "mine or quarry". Data were imported into SAS (ver. 9.2, Cary, NC). Medians and ranges are reported for ordinal variables that were not normally distributed. Reported levels of significance are from Wilcoxon rank-sum non-parametric tests.

Results and Discussion

Former pit-mine dive parks (n=157) were located in the United States (n=88), mainland Europe (n=32), United Kingdom (n=27), Canada (n=8), South America (n=1) and South Africa (n=1). Where the year of first opening was known (n=44), the median age of the dive parks was 21 years (1957-2010). The type of material formerly mined at each dive park, where known (n=112), is shown in Figure 1. Other descriptive statistics are listed in Table 1.

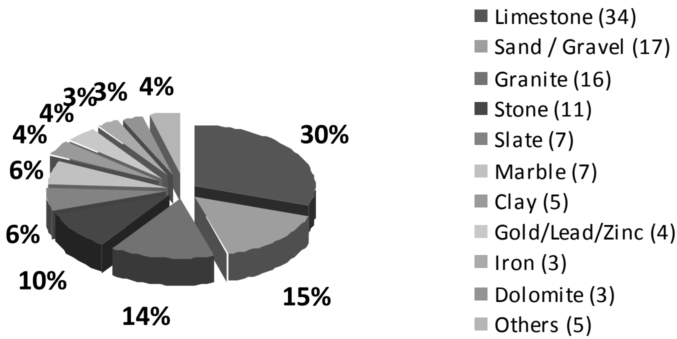

***Table 1** Descriptive statistics for dive parks.*

Characteristic	Overall (n=157) n (range)
Distance to city (km)	33 (1-320)
Surface area (ha)	6.6 (0.3-700)
Maximum depth (m)	21 (6-165)
Minimum temp (^{0}C)	7 (0-27)
Maximum temp (^{0}C)	24 (11-35)
No. of u/w attractions*	10 (1-60)
Fee per day (US$)	12 (0-35)
Altitude (m)	150 (0-1436)
Latitude from Equator (^{o})	44 (13-58)

*u/w = underwater

Dive parks advertised a median of four main types of above ground facilities (range 0-10) and the most popular were the availability of air-fills (n=65, 41%), toilets (n=65, 41%), a dive shop (n=58, 37%), camping (n=49, 31%), showers (n=43, 27%) and picnic tables (n=31, 20%). Underwater there were a median of 10 underwater attractions (range 1-60) and the most commonly advertised were small boats (n=79, 50%), training platforms (n=67, 43%), cars (n=63, 40%), large boats or ships (n=44, 28%) and aircraft (n=38, 24%).

A median of two types of fauna were advetised (range 0-10). The most common fish were perch (n=38, 24%), bass (n=37, 24%), catfish (n=33, 21%), carp (n=31, 20%) and pike (n=28, 18%). Additional park uses included rock-climbing, bungee jumping, zip-lines and windsurfing. Median price charged per diver per day was US$12 (range 0-35). Where ownership could be determined, the majority (69/85, 81%%) were privately owned. Eleven (13%) were owned by a level of government and five dive parks (6%) were owned by clubs or associations.

Discussion

The most commonly mined minerals were soft rock such as limestone, sandstone, sand and gravel (45%), followed by hard rock such as granite, marble and slate (36%). Former metal or coal mines were relatively less common. That the median age was 21 years and yet parks have been opening as recently as 2010 suggests at least a proportion of pit-mines rehabilitated as dive parks have the potential for long term sustainability and are, after half a century, still viewed as economically viable new ventures. Due to the explorative nature of this research a substantial limitation is that no water quality data were collected, nor were former dive parks that are now closed surveyed. The possibility exists that a particular combination of water quality parameters is associated with dive park sustainability. Further research is needed to establish if this is the case and, then, what those parameters are.

The reliance upon English language search terms no doubt biased the identification of dive parks towards those within English-speaking countries (USA, Canada and the UK). This may have influenced the mean latitude in this study being 44^{o} from the equator, compared with the latitudinal distribution of the world's population which has a mean within 24^{o} of the equator (Rankin 2008). The range and volume of information obtained from each web-site varied considerably and so the possibility must be considered that much of the data reported in this study is under-representative of that actually found in dive parks. The data in this study may be considered 96% reliable (entered correctly) and 60% complete (independently confirmed by anonymous survey). Even acknowledging these limitations, these results offer the first comprehensive snapshot of what constitutes a former pit-mine dive park and they may serve to stimulate additional, potentially more in-depth, research.

What effect having multiple uses available at each park, cost and/or wildlife has upon visitor number remains unexplored. Whilst this study has identified which features are most common further research is needed to identify which of the attractions and facilities are considered the most desirable by end users (divers), as has been conducted among diving populations in marine environments (Ghazali

2002). In addition to advertising what underwater attractions were available in each dive park it was common to advertise the spatial relationship between attractions. For example, if two attractions were spaced 30m apart then they may be advertised as suitable for the Advanced Open Water Diver course navigation dive (International PADI Inc 2000). How spatial distribution influences the attractiveness of objects placed underwater was not explored in this study and further research is needed if prospective dive park designers are to maximize the attractiveness of their parks.

Considering the resident diving population it remains mysterious why no dive park has been established in Australia. Abandoned pit-mines are often dived and there are many within the range of characteristics found in this study. Further research is needed to identify if the reason is environmental, (for example, water quality or the availability of ocean diving), or perhaps cultural, (for example, legal or regulatory barriers).

Conclusions

This study has identified common features among 157 former pit-mine dive parks around the world and many of those features are already found in Australia. Further research is needed to identify how best to establish the first Australian inland dive park, which will enable trainee divers to learn to dive without damaging fragile reefs offshore, will extend the dive season for diver training providers, yield an economic benefit to the nearest local urban community and enable the keenest divers to maintain their skills and social ties year round.

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