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### **A Population Explosion of the Rare Tropical/Subtropical Purple Sea Mane, *Drymonema dalmatinum*, around Puerto Rico in the Summer and Fall of 1999**

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A population explosion of millions of the purple sea mane, *Drymonema dalmatinum* Haekel (Semaestomeae: Cyaneidae; Fig. 1) occurred around Puerto Rico in the summer and fall of 1999. This event is unprecedented, although limited in geographic extent. Since other unusual, and sometimes highly destructive, jellyfish blooms are occurring worldwide, it seemed important to document this occurrence.

Many species of scyphozoan jellyfishes routinely experience drastic population increases (blooms, explosions, outbreaks or swarms) annually or less often [e.g., every 10-12 years (Queruel et al., 1996), 20-30 years (Burnett, 1996), or more (Martin et al., 1997)]. Recently, these outbreaks have been reported more often and in greater densities, and some investigators have suggested that the events may be related to global changes (Mills, in press).

*Drymonema dalmatinum* is known from the Adriatic Sea, Mediterranean, Atlantic Ocean off Gibraltar and Brazil, the Caribbean Sea, and south Florida (Larson, 1987). Larson specifically noted specimens of *D. dal-*



FIG. 1. Purple sea mane, *Drymonema dalmatinum* Haekel, 20 cm in diameter with young Atlantic bumpers, *Chloroscombrus chrysurus* (Linnaeus), off La Parguera, Puerto Rico. Photograph by Ronald J. Larson.

*matinum* from Puerto Rico and the U.S. and British Virgin Islands. This species has also been noted recently in Argentina, Brazil and Colombia (Cornelius and Silveira, 1999; Mianzan, 1989a,b, Table 1). The occurrence of *D. dalmatinum* is rare to sporadic throughout its range, sometimes disappearing for 30 years in the Adriatic (Stiasny, 1940). The exact distribution of *D. dalmatinum* has been poorly documented, particularly in the western Atlantic. We list some museum records to further document its occurrence (Table 1).

Many millions of this large and distinctive jellyfish were reported around all coasts of Puerto Rico and the offshore islands of Culebra and Vieques from June through October 1999. Casual reports from Mona Island were discredited by Carlos Diez (DNER, pers. comm.), who dove around Mona Island many times in July, August and September, but those from the other areas were substantiated by local scientists and documented with photographs. The most dense concentrations occurred along the northeast coast of Puerto Rico and Culebra Island. Concentrations there ranged from 1-12 individuals per 25 m<sup>2</sup> surface area, while those along the other coasts were 1-3/25 m<sup>2</sup>. The reported densities were skewed toward the higher values because reports were often received when jellyfish were present at higher densities and attracted attention.

TABLE 1. Depositions of the purple sea mane, *Drymonema dalmatinum* Haekel, in the U.S. National Museum and University of Puerto Rico collections

Locality	Number	Year	Museum number
off La Parguera, PR	2	1999	no number <sup>1</sup>
off NE PR	2	1999	no number <sup>2</sup>
E of Charleston, SC <sup>3</sup>	3	1885	USNM 17362
Guana Island, BVI	9	1975	USNM 54395
Puerto Rico	2	1974	USNM 54395
Puerto Rico	1	1974	USNM 54471
Bermuda	10	1898	USNM 58679
Santa Cruz, Argentina <sup>4</sup>	1	1978	USNM 79945

<sup>1</sup>Invertebrate Collection of the Department of Marine Sciences, University of Puerto Rico at Mayagüez; <sup>2</sup>Invertebrate Collection of the Biology Department, University of Puerto Rico at Humaco; <sup>3</sup>R/V Albatross at 32°27'30"N, 77°20'30"W; <sup>4</sup>Grande Bay, Punta Loyola, 51°23'S, 68°53'W; BVI = British Virgin Islands; N = north; NE = northeast; PR = Puerto Rico; SC = South Carolina, USA; USNM = U.S. National Museum, all specimens in USNM were identified by R. J. Larson.

During August 1999, we made a 10 km transect off the northeast coast of Puerto Rico counting *D. dalmatinum* specimens 10 m on either side of the tract. Temperature, salinity, and water visibility measurements were not taken. Several other boat operators reported the number of jellyfish seen along their tracts. Observers varied from professional marine scientists to amateurs without biological or scientific training. Since numerous methods of counting and estimating jellyfish densities were used, standardization of the data to exact numbers of jellyfish was impossible. The presence of jellyfish seemed relatively constant throughout the summer and fall of 1999, although usually at the lower end of the density ranges given above or less (probably averaging 1/100 m<sup>2</sup>). The densities seemed higher during July and August, but the data are not sufficient for statistical analysis.

If we estimate at 5000 km<sup>2</sup> the surface area of near-shore waters and adjacent waters around Puerto Rico (also with reports of *D. dalmatinum*), we can calculate the approximate number of *D. dalmatinum* present at a particular time in the outbreak by multiplying the surface area in km<sup>2</sup> (5000) by the number of *D. dalmatinum* per 100 m<sup>2</sup> surface area (1) and by the surface area conversion factor (1 million/100):

$$N = (5000)(1)(10,000) = 50 \text{ million individuals}$$

Due to the high variability in quality of data and lack of consistency in the reports, we can assume up to a 50 % error and still estimate a minimum of 25 million jellyfish (25-75 million). Obviously, this was a large-scale event. A population increase in moon jelly, *Aurelia aurita* (Linnaeus), coincided with the highest densities of *D. dalmatinum* in July-August. Only a few

observers reported this increase because an outbreak of *A. aurita* is almost an annual occurrence around Puerto Rico and in other Caribbean localities. The favorable conditions for the *D. dalmatinum* outbreak may have been caused partially by the availability of *A. aurita*, since *D. dalmatinum* preys on it (Stiasny, 1940; Larson, 1977, 1987). Larson (1987) found a 3-5% conversion rate of *D. dalmatinum* preying on *A. aurita*. Thus, at least 20 times more mass of *A. aurita* were needed to support the *D. dalmatinum* outbreak. The numbers of *A. aurita* around Puerto Rico can be conservatively estimated by multiplying the lowest size or mass difference between *D. dalmatinum* and *A. aurita* (4:1 to 2:1) by the number of individuals of *D. dalmatinum* at one time in the outbreak (50 million) and by the highest Larson (1987) conversion factors (33.1:1 to 20:1):

$$N = 2 \times 50 \text{ million} \times 20 = 2 \text{ billion individuals}$$

*Drymonema dalmatinum* may play an important role in regulating *A. aurita* populations and protecting other planktivores. A mass bloom of *A. aurita* can remove almost all zooplankton from the water column and starve other planktivores. Sessile, coral-reef organisms could be particularly damaged as water borne plankton must pass through a swarm of *A. aurita* to reach the reefs.

Two specimens of *D. dalmatinum* collected from the southwest coast of Puerto Rico are in the University of Puerto Rico Invertebrate Collection housed at the Department of Marine Sciences (DMS) and two collected from the northeast coast are in a collection at the Humacao Campus of the University of Puerto Rico (Table 1). Although specimens were not collected from other observation sites, diagnostic-quality photographs were examined from most sites.

Information requests through the Caribbean Coastal Marine Productivity Network (CARICOMP) produced only one, possibly unrelated report. A major population explosion of an unidentified jellyfish began in the Bocas del Toro Region of Panama in early August 1999. Such outbreaks have occurred several times in this region since 1997 (H. Guzman, Smithsonian Tropical Research Institute, pers. comm.). Without an identification of the Panama jellyfish, we cannot be certain if this was part of the same or a similar event. However, the lack of similar reports from the U.S. Virgin Islands, the British Virgin Islands, and the Dominican Republic suggest that the event reported here was limited geographically.

Specimens of *D. dalmatinum* varied in bell diameter from 2 to 111 cm. In-water estimates of bell diameters ranged from 150 to 200 cm. The largest size previously reported for this species was a bell diameter of 75 cm (Larson, 1987), although specimens up to 100 cm have been measured (Larson, unpubl. data).

Markings on the bell varied from pink in smaller specimens, through purple, to brownish purple in larger ones. Tentacles trailed behind the bell for many meters. Observers reported stings from contact with the tentacles, but with little tissue damage and no toxic reactions.

Many observers reported seeing small jacks beneath

the bell of the jellyfish (Fig. 1). The few specimens of these fishes that we obtained were juvenile or young Atlantic bumpers, *Chloroscombrus chrysurus* (Linnaeus), but other fish species may have also been associated with this jellyfish and not collected. This fish species has been reported to associate with *D. dalmatinum* (Larson, 1987).

No observer or biologist recalled seeing this species of jellyfish before in Puerto Rico, and no one could immediately identify it to species. A former DMS invertebrate zoologist, Charles E. Cutress (deceased) deposited specimens of *D. dalmatinum* collected in Puerto Rico in the DMS Invertebrate Collection (Table 1). In the last 26 years, EHW, LBW, and NAE only observed and photographed a single specimen in the field in October 1974, although Larson (1987) found 13 off La Parguera, Puerto Rico in December 1974. This species is apparently more common in the U.S. Virgin Islands (Larson, 1977, 1987, unpubl. data). Larson (1987) noted 50 in a small bay near Monkey Pt., Guano Island, British Virgin Islands. Cutress (pers. comm.) knew of no outbreaks or increased abundance for this species in Puerto Rico or the Caribbean.

We are aware of one other recent outbreak of a jellyfish in the West Indies (besides the routine *A. aurita* outbreaks). Swarms of thimble jellyfish, *Linuche unguiculata* (Schwartz), have caused severe skin rashes in tourists from south Florida throughout the Caribbean in the 1990s (Black et al., 1995). More important recent outbreaks occurred in other species of jellyfish in the northern Gulf of Mexico (Perry and Graham, 2000), Chesapeake Bay, USA (Purcell et al., in press), the Black Sea and eastern Mediterranean (Lotan and Ben-Hillel, 1992; Lotan et al., 1994), and the Bering Sea (Brodeur et al., 1999).

In early September 2000, a population explosion of *D. dalmatinum* began in the northern Gulf of Mexico from Louisiana to Florida and persisted for several months. This second known outbreak of *D. dalmatinum* occurred approximately one year after the Puerto Rican event. It was also similar because an outbreak of *A. aurita* preceded and coincided with the event just as in Puerto Rico. It differed from the Puerto Rican event by being preceded by a population explosion of the spotted jellyfish, *Phyllorhiza punctata* von Lendenfeld, which occurred in the same portion of the northern Gulf of Mexico in the spring and summer of 2000 (Perry and Graham, 2000; Perry et al., in press). These jellyfish may have also provided some prey items to support the *D. dalmatinum* outbreak. Both *D. dalmatinum* and *P. punctata* had not previously been noted in the northern Gulf of Mexico and were considered exotic species of tropical origin.

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