

Do the same sponge species live on both the Caribbean and eastern Pacific sides of the Isthmus of Panama ?

by Janie L. WULFF

Abstract

Some species of shallow water sponges appear to occur on both the Caribbean and eastern Pacific sides of the Isthmus of Panama. Analysis of four of these species by traditional taxonomic techniques, including measurement of spicules and examination of skeletal construction, combined with ecological information, such as habitat distribution and palatability to fish predators, fails to distinguish between sponges living in one ocean from those living in the other.

Keywords : Caribbean sponges, eastern Pacific sponges.

Resumen

Parece que algunas especies de esponjas viviendo en aguas de poca profundidad pueden ocurrir en ambos lados del Istmo Panameño, tanto en el Caribe como en el Pacífico oriental. En cuatro especies de esponjas analizadas, usando las técnicas tradicionales, como las medidas de los espículos y observaciones de la estructura del esqueleto combinado con información de la ecología, incluyendo distribución y si a los peces pueden consumirlas, no se puede distinguir entre las esponjas de los dos lados.

Palabras claves : Esponjas del Caribe, esponjas del Pacífico Oriental.

Introduction

Diversity and abundance of sponges are dramatically lower on the eastern Pacific side of the Isthmus of Panama than on the Caribbean side (e.g., GLYNN, 1982), with only 21% as many species reported from the Tropical eastern Pacific region as from the Caribbean (134 species vs. 640 species, VAN SOEST, 1994). The relatively few species in the eastern Pacific are small and tend to be cryptic. At Panama, some of the more abundant species appear very similar to species known from the Caribbean in color, spicule and skeletal characters, and also in ecological characters. In his 1936 report of collecting sponges in Panama in 1933, DE LAUBENFELS also mentioned what he considered to be a striking similarity in sponge fauna on the Caribbean and Pacific sides of the Isthmus. Of the 16 species he collected in the eastern Pacific and

the 21 species he collected in the Caribbean at Panama, he considered 6 to be the same in both oceans. Many of DE LAUBENFELS' specimens have been restudied and re-assigned to different taxa (e.g., VAN SOEST, 1980; RÜTZLER & SMITH, 1993), casting reasonable doubt on his conclusions that the same sponge species occur on both sides of the Isthmus. However, his conclusions have not been reevaluated in the context of the sponge populations in the field in Panama. I report here on sponges that I collected in locations as close as possible to where DE LAUBENFELS collected and compare my specimens to each other and to his. For the 4 species, or pairs of sibling species, studied here I conclude that, even though his specimens do not support his conclusions, DE LAUBENFELS' (1936) evaluation of the similarity of some sponges in the two oceans is basically correct.

Methods

Over a period of some years of field work in Panama, sponges were collected from shallow (less than 4 m below LMW) areas, by snorkeling, and also from the extreme low intertidal zone at coastal and offshore sites on both sides of the Isthmus. In the Caribbean, sponges were collected at Galeta (mangroves, reef flat - lagoon, reef), on the mainland 7 km from the Atlantic terminus of the Canal and less than 3 km from Fort Randolph, where DE LAUBENFELS collected; and also in the San Blas Islands (well-developed reefs, mangroves), offshore (Fig. 1). In the eastern Pacific, sponges were collected at Perico (extreme low intertidal cobbles), on the Panama City side of the Pacific terminus of the Canal; at Taboga (rock walls, coral rubble, and some corals), a near shore island affected by seasonal upwelling; at Las Perlas (reefs and rock walls), islands further out in the Bay of Panama; and at Isla Uva and the Secas Islands (well-developed reefs, rock walls) offshore in the Gulf of Chiriqui (Fig. 1). Collecting was not meant to be exhaustive, but was focused on collecting representatives of

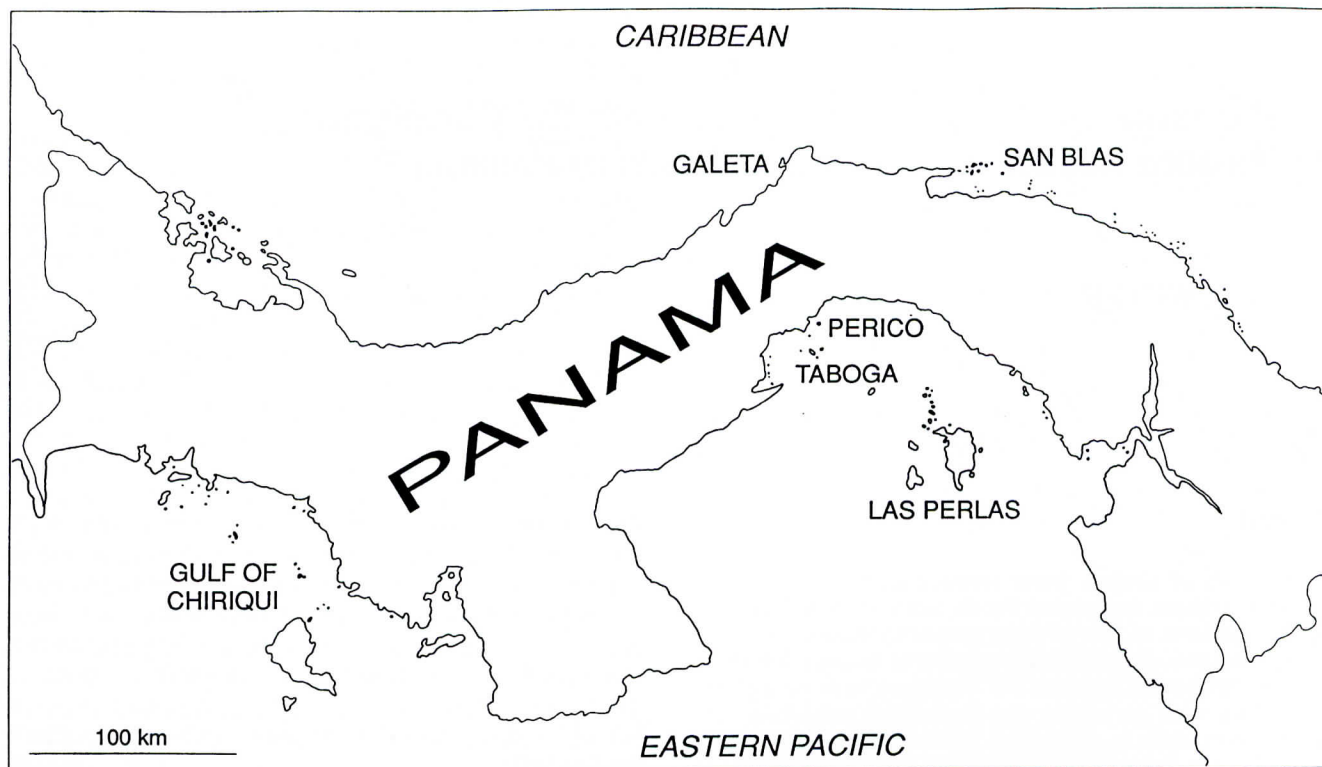


Fig. 1. - Map of Republic of Panama showing collecting sites in the Caribbean and eastern Pacific.

species that were sufficiently common to be used in ecological experiments.

Ecological notes were made on each species with respect to distribution, habitat, palatability to potential predators, and range of growth forms. Traditional techniques for sponge taxonomy were employed, including analyses of preparations of dissociated spicules (50 megascleres were measured for each specimen) and examinations of surface and internal skeletal construction.

Results

Order Hadromerida Family Spirastrellidae

Spirastrella cf. mollis VERRILL

This encrusting, but compressible, sponge is dull salmon-brown, with the interior tending to be more brick colored. The surface is very smooth, and inflated canals are visible in live sponges. In the Caribbean it was found in shallow back-reef (San Blas) and lagoon and reef flat areas (Galeta), mainly on rubble and on sides of dead coral heads. This species does not forsake its encrusting morphology, although, when one individual completely covers coral rubble with a thin crust, the entire mass may appear to be a massive sponge. In the eastern Pacific it was found on shallow rock walls adjacent to coral reef or coral community

areas (Taboga, Las Perlas, and the Gulf of Chiriqui).

Specimens collected by me in the Caribbean (San Blas) and in the eastern Pacific (Gulf of Chiriqui) cannot be distinguished readily by spicule characters (Fig. 2). The tylostyles do not differ significantly in length (Table 1; ANOVA, $P > 0.1$). The largest class of spirasters was also compared (20 spicules per specimen) with respect to two shape variables: length/width ratio and spines/unit length. Length/width ratio did not differ significantly among specimens (ANOVA, $P > 0.25$). The number of spines/unit length did differ significantly among the specimens (ANOVA, $P < 0.005$), but the greatest difference was between specimens collected in the same ocean (Table 1). Specimens from both oceans were rejected as food by all fish tested except the Caribbean sponge-specialists *Pomacanthus arcuatus* (LINNAEUS) and *P. paru* (BLOCH) (WULFF, 1994, in review, and unpublished data). The typical habitat is somewhat different in the two oceans, but at least part of this difference is due to the lack of vertical rock walls in shallow water on the Caribbean side of Panama.

DE LAUBENFELS (1936) tentatively referred to a specimen that he collected in Panama as *Spirastrella cunctatrix* SCHMIDT, though he acknowledged that it differed in minor ways from the Mediterranean species. He referred to it as "bright orange" in his 1936 paper, but he labeled his specimen USNM 22236 as "salmon pink". He found this specimen at Fort Randolph (Caribbean), but found no *Spirast-*

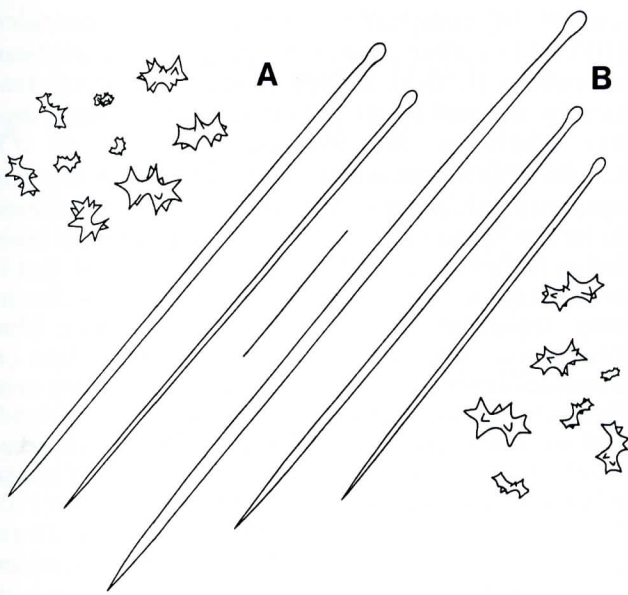


Fig. 2. - Spicules of *Spirastrella* cf. *mollis* VERRILL in the eastern Pacific, YPM 21028 (A) and Caribbean, YPM 21026 (B), (scale bar = 100 μ m).

rella specimens in the Pacific, possibly because the rock wall habitat there would have made them difficult to discover by his collecting techniques of wading and collecting by hand or dredging from a rowboat with a rake. Tylostyle lengths and spiraster shapes of his specimen suggest that it is an example of *S. coccinea* (Table 1).

There seem to be at least two similar species of encrusting *Spirastrella* in the Caribbean, and some confusion has resulted. HECHTEL (1965) apparently found specimens assignable to the present species in Jamaica, and mentions the similarity of the spicules to those figured by TOPSENT for *Spirastrella cunctatrix* SCHMIDT. However, when HECHTEL examined specimens (YPM 714 and USNM 22498) that DE LAUBENFELS had assigned to *S. coccinea* (DUCHASSAING & MICHELOTTI), he could not distinguish them from his Jamaican specimens, and therefore applied the earlier name, *S. coccinea* to the Jamaican specimens (HECHTEL, 1965). WIEDENMAYER (1977) collected specimens of two *Spirastrella* species at Bimini in the Bahamas, and distinguished between them on the basis of color, habitat, and spicules, pointing out especially that DUCHASSAING & MICHELOTTI had specifically described *S. coccinea* as a red ("rouge vif") sponge. I have collected specimens assignable to both species within a meter of each other in San Blas, and their spicules show the same distinctions figured and described by WIEDENMAYER (1977) and also by PULITZER-FINALI (1986); i.e., my specimen referred to *Spirastrella coccinea* (YPM 21044) was a bright orange-red color in life, the tylostyles are larger (t-test, $P < 0.001$), the spirasters are significantly wider relative to their length (t-test, $P < 0.001$), and the spirasters have significantly

fewer spines per unit length (t-test, $P < 0.001$) than the specimen that was collected nearby and referred to *S. cf. mollis* (YPM 21026), which has the characteristics of sponges referred to *S. cunctatrix* by WIEDENMAYER (1977) and PULITZER-FINALI (1986). VERRILL's (1907) specific name "*mollis*", has been applied by RÜTZLER (1986) to sponges with the characteristics of *S. cunctatrix* as described above, in a guide to identification of Bermudan sponges, distinguishing this Caribbean (and possibly also eastern Pacific) species from the Mediterranean species. Unfortunately, VERRILL (1907) did not indicate the color in his description, his figures of the spicules show indentations in the heads of the tylostyles and abrupt angles in the shafts of the large spirasters that are not evident in any of the extant specimens, and his type specimen (no YPM number) is missing from the Yale Peabody Museum. Spirasters in a Bermuda specimen (YPM Bermuda nr 122) of *S. mollis* are more homogeneous in size and appear more like those pictured by VERRILL (1907); thus it is possible that the specimens reported here, as well as those of HECHTEL, WIEDENMAYER, and PULITZER-FINALI, are representatives of a third species of Western Atlantic *Spirastrella*.

Order Haplosclerida Family Chalinidae

Haliclona caerulea (HECHTEL)

This lovely blue sponge, which is sometimes densely permeated with various species of macroalgae, was described from Jamaica by HECHTEL (1965). In the Caribbean at Panama I have found specimens assignable to this species on mangrove roots, pilings, and coral rock in a reef-flat-lagoon (Galeta) and also on mangrove roots (San Blas). In the eastern Pacific specimens were found associated with the bases of branching corals (*Pocillopora*) on the few well-developed reefs in this area (Gulf of Chiriqui). Other blue Halposclerida occur in the eastern Pacific at Panama. *Haliclona caerulea* is distinguished from them by the tendency to become associated with macroalgae and the presence of sigmas (slightly crimped centrally).

Specimens referred to *H. caerulea* from both oceans at Panama exhibit the incomplete unispicular tangential reticulation typical of the surfaces of HECHTEL's species, and the typical sigmas are common in all specimens. Sigma shapes (Fig. 3) and lengths were not significantly different among all specimens collected from the Caribbean and eastern Pacific (Table 2; ANOVA, $P > 0.1$). On the basis of oxea size and shape, however, the specimens can be divided into two internally homogeneous groups, each with representatives from both oceans. The oxeas of one sub-group of the specimens (YPM numbers 21031, 21032, 21033, and 21034),

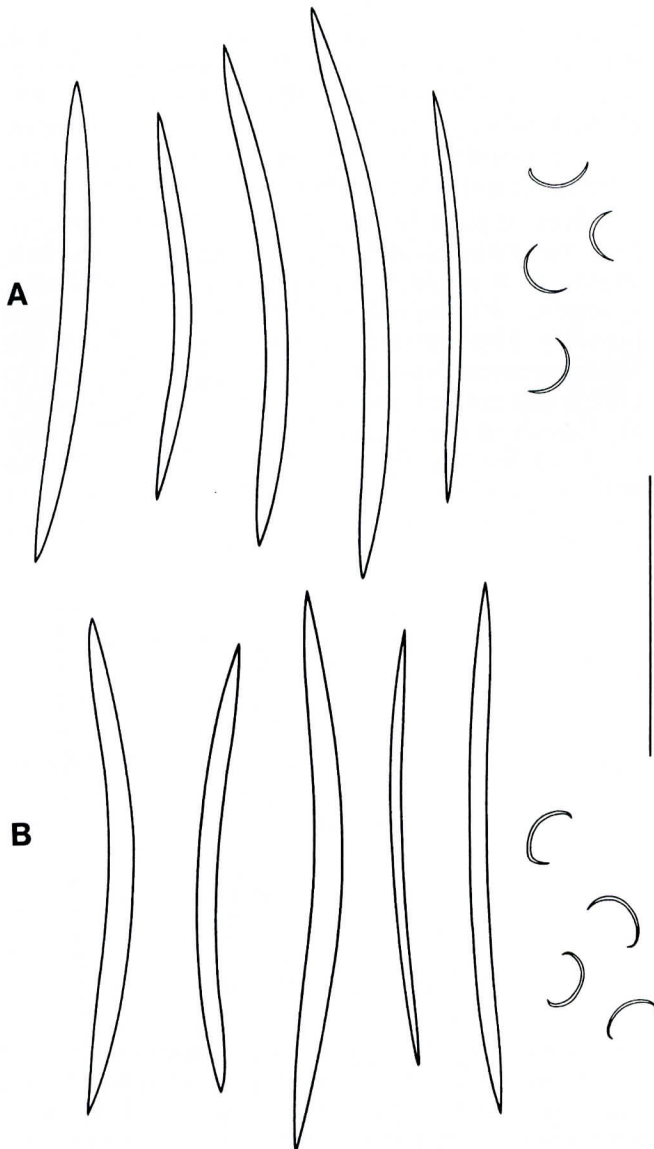


Fig. 3. - Spicules of *Haliclona caerulea* (HECHTEL) in the Caribbean, YPM 21031 (A) and eastern Pacific, YPM 21033 (B), (scale bar = 100 μm).

including representatives from both oceans, do not differ significantly in length (ANOVA, $P > 0.75$) and are shaped as drawn in Figure 3. Likewise, oxeas of specimens in the other sub-group (YPM 21030, YPM 21035 and USNM 22240), also with representatives from both oceans, do not differ significantly in length (ANOVA, $P > 0.5$). Some justification for separate consideration of these subgroups lies in the shape difference of the oxeas. The oxeas in specimens of the second subgroup are not only significantly longer (Table 2), but they are also slightly bent centrally and have more gradually tapering ends.

DE LAUBENFELS (1936) referred to "the distinctive blue color" of what he called *Haliclona coerulescens* (TOPSENT), of which he reported that he had collected specimens on both sides of the Isthmus. VAN SOEST (1980) considered DE LAUBENFEL's spe-

cies to be conspecific with *Haliclona caerulea* (HECHTEL) after examining one of his Caribbean specimens (USNM 22240). However, a reexamination by me and by DE WEERDT (pers. comm., and her labels on the specimens) of all of DE LAUBENFELS' specimens has revealed that this one specimen, which DE LAUBENFELS (1936) considered to be the "most typical" of the 5 specimens he labeled as *Haliclona coerulescens*, is the only one that is conspecific with *H. caerulea*. His Pacific specimens may represent one or more of the other blue *Haliclona* species that are currently abundant on intertidal cobbles at Perico on the Pacific coast near Panama city, on rocks and rubble at Taboga Island, and on the reefs of Las Perlas (personal observation). The spicule complement of each of these other species is solely oxeas, of smaller sizes (110-150 μm) than those of *Haliclona caerulea*. Thus, DE LAUBENFELS' specimens do not support his claim of finding the same blue *Haliclona* species on both sides of the Isthmus, but there are populations of a sky-blue *Haliclona* species, or a related pair of species, living on both sides of the Isthmus.

Order **Halichondrida**
Family **Halichondriidae**

Halichondria cf. *lutea* ALCOLADO
and
Halichondria cf. *magniconulosa* HECHTEL

Two species, or pairs of related species, of *Halichondria*, as defined by DIAZ *et al.* (1993), appear to inhabit both oceans at Panama. Specimens tentatively assigned to *Halichondria lutea* ALCOLADO, were found living entirely cryptically within the reef frame or partially consolidated rubble of the branching corals of the genera *Porites* in the Caribbean (San Blas), and *Pocillopora* in the eastern Pacific (Gulf of Chiriqui). All of the specimens are pale yellow-orange and extremely cavernous in architecture, with wide thin-walled canals. They are consequently quite delicate and easily broken when removed from their cavities. The cryptic habitat appears to be forced upon this species in both oceans by its susceptibility to predation by generalist fishes whenever it is removed from its cryptic spaces (WULFF, 1988; in review; unpublished data). The spicules, large oxeas (Fig. 4), are statistically indistinguishable by length (ANOVA, $P > 0.1$) and by width (ANOVA, $P > 0.25$) in the 2 oceans. These specimens are assigned to *Halichondria lutea* with reservation because the oxeas of the holotype (USNM 39232) are significantly longer (t-test, $P < 0.001$) than those of the Panama specimens and tend to be quite curved. Although the Panama specimens have the same color and skeletal characteristics as *H. lutea* (DIAZ *et al.*, 1993), they appear different from the holotype of *Halichondria lutea*, the surfaces of



Fig. 4. - Spicules of *Halichondria* cf. *lutea* ALCOLADO in the Caribbean, YPM 21036 (A) and eastern Pacific, YPM 21038 (B), (scale bar = 100 μ m).

which seem to be bristling with spicules and small projections, rather than smooth. *Halichondria lutea* specimens were reported by DIAZ *et al.* (1993) to be found typically in deep (25-50 m) water, and usually covered by sediment; whereas I have only found specimens in very shallow (< 3 m) water, in crevices in the reef frame. Since small rough projections are typical of some sponges growing in areas where they are covered by sand, it is possible that these specimens all represent the same species, and that this difference in surface morphology is related to the different habitats from which the specimens were collected.

Specimens of the second *Halichondria* species are dull pale yellow with tinges of blue on the surface and dull yellow-orange in the interior, and were found growing thickly (1-5 cm) on mangrove roots (Caribbean at Galeta) or floating docks (Pacific at

Balboa) or in cryptic spaces between cobbles in the low intertidal (Pacific at Perico). This species appears to be unusually tolerant of mistreatment, recovering even after intertidal exposure in midday heat. The spicules of these specimens, large oxeas (Fig. 5), are not distinguishable from those of the Panama specimens of *Halichondria* cf. *lutea* by length (t-test, $P > 0.5$), but oxea widths are significantly greater (t-test, $P < 0.001$; Fig. 5), and the skeletal architecture is different. These are densely and coarsely constructed sponges, everywhere bristling with spicules when the interior is exposed by cutting or breaking. The surfaces, which can appear rather wrinkled, are characterized by a rather coarse tangential reticulation seen very clearly between the small conules.



Fig. 5. - Spicules of *Halichondria* cf. *magniconulosa* HECHTEL in the Caribbean, YPM 21040 (A) and eastern Pacific, YPM 21042 (B), (scale bar = 100 μ m).

Table 1 :
Specimens assigned tentatively to *Spirastrella mollis* VERRILL, as well as specimens assigned to *S. coccinea* (DUCHASSAING & MICHELOTTI).

<i>Spirastrella cf. mollis</i> VERRILL				Tylostyle length			Spiraster shape - largest size class only		
Location	Collector	Specimen nr	Range	Mean	(std dev)	length/width ratio mean (std dev)	spines/ μ m mean (std dev)		
Carib - S BI	JLW	YPM 21026	320-580	414.2	(50.6)	1.48 (0.13)	0.30 (0.04)		
Carib - S BI	JLW	YPM 21027	290-550	420.8	(71.5)	1.48 (0.14)	0.28 (0.03)		
E Pac - Chir	JLW	YPM 21028	330-480	399.2	(37.5)	1.45 (0.14)	0.32 (0.03)		
E Pac - Chir	JLW	YPM 21029	310-560	403.6	(51.8)	1.43 (0.14)	0.28 (0.03)		
<i>Spirastrella coccinea</i> (DUCHASSAING & MICHELOTTI)				Tylostyle length			Spiraster shape - largest size class only		
Location	Collector	Specimen nr	Range	Mean	(std dev)	length/width ratio mean (std dev)	spines/ μ m mean (std dev)		
Carib - S BI	JLW	YPM 21044	410-650	513.8	(63.6)	1.18 (0.07)	0.22 (0.06)		
Carib - F Rn	MWDL	USNM 22236	350-660	461.0	(53.6)	1.24 (0.17)	0.22 (0.02)		

Table 2 :
Specimens assigned to *Haliclona caerulea* (HECHTEL).

<i>Haliclona caerulea</i> (HECHTEL)				Oxea lengths			Sigma lengths		
Location	Collector	Specimen nr	Range	Mean	(std dev)	Range	Mean	(std dev)	
Carib - Gal	SGSL	YPM 21030	150-192	175.2	(8.7)	16.3-22.5	19.8	(1.4)	
Carib - Gal	JLW	YPM 21031	143-185	168.6	(11.1)	15.0-22.5	19.3	(1.6)	
Carib - S BI	JLW	YPM 21032	140-190	170.8	(10.2)	16.2-22.5	20.0	(1.5)	
E Pac - Chir	JLW	YPM 21033	147-197	169.7	(11.3)	17.5-22.5	19.6	(1.3)	
E Pac - Chir	JLW	YPM 21034	155-192	169.5	(6.1)	15.0-22.5	19.6	(1.9)	
E Pac - Chir	JLW	YPM 21035	120-200	176.3	(17.7)	12.5-23.7	19.3	(2.4)	
Carib - F Rn	MWDL	USNM 22240	140-200	174.6	(13.2)	15.0-21.2	18.1	(1.5)	

Table 3 :
Specimens assigned tentatively, to *Halichondria lutea* ALCOLADO, compared with the holotype, specimen USNM 39232.

<i>Halichondria cf. lutea</i> ALCOLADO			Oxea lengths			Oxeas widths		
Location	Collector	Specimen #	Range	Mean	(std dev)	Range	Mean	(std dev)
Carib - S BI	JLW	YPM 21036	370-830	548.2	(100.0)	5.0-16.3	8.6	(3.2)
Carib - S BI	JLW	YPM 21037	360-670	524.4	(81.6)	3.8-16.3	9.2	(3.6)
E Pac - Chir	JLW	YPM 21038	340-660	540.2	(64.0)	3.8-12.5	8.1	(2.4)
E Pac - Chir	JLW	YPM 21039	330-640	514.4	(75.8)	3.8-20.0	8.6	(3.5)
<i>Halichondria lutea</i> ALCOLADO			Oxea lengths			Oxeas widths		
Carib - Cuba	PMA	USNM 39232	550-1090	802.6	(102.3)	2.5-11.3	7.6	(2.8)

Table 4 :
Specimens assigned tentatively to *Halichondria magniconulosa* HECHTEL, compared with one of HECHTEL's specimens, YPM 5221, from the type locality.

<i>Halichondria cf. magniconulosa</i> HECHTEL			Oxea lengths			Oxeas widths		
Location	Collector	Specimen #	Range	Mean	(std dev)	Range	Mean	(std dev)
Carib - Gal	SGSL	YPM 21040	320-700	524.0	(95.5)	5.0-22.5	12.8	(5.1)
Carib - Gal	SGSL	YPM 21041	330-680	509.6	(88.1)	3.8-21.3	11.1	(4.8)
E Pac - Per	JLW	YPM 21042	230-780	486.8	(112.4)	5.0-20.0	12.1	(4.3)
E Pac - Per	JLW	YPM 21043	350-680	512.6	(83.2)	3.8-18.8	10.9	(3.6)
Carib - F Rn	MWDL	USNM 22232	390-920	614.8	(133.2)	5.0-25.0	12.6	(5.5)
<i>Halichondria magniconulosa</i> HECHTEL			Oxea lengths			Oxeas widths		
Carib - Jam	GJH	YPM 5221	180-350	265.0	(38.9)	2.5-6.2	3.8	(1.3)

Captions of Tables 1-4 :

- All measurements are given in μm .

- Collectors : JLW = Janie WULFF, SGSL = Stephen GARRITY and Sally LEVINGS, GJH = George HECHTEL, MWDL = M.W. DE LAUBENFELS, PMA = Pedro ALCOLADO.

- Locations : Gal = Galeta, Per = Perico, Jam = Jamaica, F Rn = Fort Randolph, Ph C = Panama City, S BI = San Blas Islands, Chir = Gulf of Chiriqui.

The specimens collected in the Caribbean and eastern Pacific at Panama cannot be distinguished by color, skeletal architecture, overall morphology, or oxea lengths (ANOVA, $P > 0.25$) and widths (ANOVA, $P = 0.1$).

These specimens are tentatively assigned to *Halichondria magniconulosa* HECHTEL because the skeletal characteristics and color agree with both the description by HECHTEL (1965) and the specimen pictured and described by DIAZ *et al.* (1985, pp. 32 and 35) for which they give mean oxea length as 336.9 μm and mean width as 4.8 μm , and which they assign to *Halichondria magniconulosa*. HECHTEL (1965) gave oxea lengths of 108-369 μm , for 3 specimens combined, and my measurement of spicules of his specimen YPM 5221 concur (Table 4). Thus, the spicules of the Panama specimens are significantly larger (t-tests, $P < 0.001$ for comparisons of both length and width) than those of HECHTEL's specimen, and the darkening in alcohol described by him and by DIAZ *et al.* (1993) did not occur with Panama specimens from either ocean.

DE LAUBENFELS (1936) referred specimens that he found on both sides of the Isthmus to *Halichondria panicea*, with some reservations about how to distinguish different species within this genus. Oxeas from his specimen labeled *H. panicea* (Pallas) from Fort Randolph (USNM 22232) are not significantly different in length (t-test, $P > 0.5$) from the Panama specimens in the present study, and they do not differ significantly in width (Table 5; t-test, $P > 0.5$) from those assigned to *H. cf. magniconulosa*. However, DE LAUBENFELS' eastern Pacific specimen, USNM 22202 has much smaller oxeas (mean length = 248.8 μm , mean width = 5.8 μm), with abrupt points, in a narrow size range (230-290 μm); and it is not clear that the very small and fragile fragment is from a halichondriid. Thus, once again, although DE LAUBENFELS' specimens do not support his conclusion that a species of *Halichondria* inhabits both sides of the Isthmus, two species, or pairs of related species, do appear to be represented in both oceans.

Discussion and Conclusions

A variety of animals with conspecific populations or geminate (JORDAN, 1908) species on both sides of the Isthmus of Panama have been studied, using traditional morphological techniques, reproductive compatibility, mtDNA, and allozymes. Pairs of geminate species of sea urchins (BERMINGHAM & LESSIOS, 1993) and of snapping shrimps (KNOWLTON *et al.*, 1993) have been used to investigate rates of protein and mtDNA evolution and also the geological history of the closure of the Isthmus. In some cases, morphology gives a clear indication of which species are geminates. For example, geminate species pairs defined on the basis of color and

morphology among snapping shrimps of the genus *Alpheus* were corroborated by studies of behavior, allozymes, and mtDNA (KNOWLTON *et al.*, 1993). Distinction of populations that are conspecific from those that are geminate species requires techniques beyond morphological analysis; and so, for the present, whether the sponges in the present study represent conspecific populations or geminate species is not resolved. Similar species of sponges on both sides of the Isthmus are not necessarily surprising in view of the many other animals that have been demonstrated or inferred to live on both sides of the Isthmus. For example, 2.5 percent of the shore fishes of the eastern Pacific are shared with the western Atlantic (ALLEN & ROBERTSON, 1994); seven genera of shallow water regular sea urchins in the Caribbean are each represented in the eastern Pacific by geminate species, or conspecific populations (LESSIOS, 1979); and incidence of species of bivalves, gastropods, decapod crustaceans, stomatopods, and polychaetes with cognates in the Caribbean and eastern Pacific listed by VERMEIJ (1979; pp. 214-215) range from 15% to 100%, depending on the habitat and taxon considered. However, in view of the lack of similarity in coral fauna between reefs on the two sides of the Isthmus, with only two genera and no species in common (GLYNN *et al.*, 1973), a scenario for how coral reef-associated sponges might be similar is not immediately obvious.

Representatives of two species, or two species pairs, of *Halichondria* were found in the present study. Specimens assignable to *Halichondria cf. lutea* were not found on the coast, but only on off-shore reefs on both the Caribbean and eastern Pacific sides of the Isthmus. This species appears to be poorly defended against predators, and is confined to cryptic spaces within the reef for this reason in both oceans. In contrast, specimens assignable to *Halichondria cf. magniconulosa* were found only in nutrient-rich coastal sites in both oceans, and this species appears to be particularly tolerant of conditions generally considered to be adverse for sponges. Specimens assignable to *Haliclona caerulea* were also found in both the Caribbean and eastern Pacific at Panama. In both oceans, specimens of this species are frequently found densely perfused with various macroalgae, especially algal species with calcareous skeletons, such as articulated coralline reds and the genus *Halimeda*. Specimens of a fourth species, *Spirastrella cf. mollis*, or pair of related species, appear to be well-defended from predators, and were found on vertical surfaces in both oceans, but were especially abundant on rock walls in the eastern Pacific, a habitat that is not available in shallow water in the Caribbean at Panama. Although DE LAUBENFELS, in his 1939 paper, reported finding conspecific representatives of two of these genera on both sides of the Isthmus, his specimens do not support his conclusions, even though his field observations may have done so.

If all 4 of these species, or species pairs, were representative of coastal habitats near the terminal points of the Panama Canal, the slight possibility that conspecific sponges living on both sides of the Isthmus could have resulted from transport on boat bottoms between oceans during the more than 8 hours in fresh water of a Canal transit would have to be considered. However, two of these species were only found on off-shore reefs in the Gulf of Chiriqui, in spite of vigorous searching both on the coast near the Pacific terminus of the canal and also on reefs in Las Perlas, off-shore islands in the Bay of Panama. If analyses of cellular and molecular characters corroborate the existence of conspecific sponges on the two sides of the Isthmus, explanations of how the sponge fauna is similar on both sides of this barrier while the coral fauna, with which the sponges are closely associated, is not, will be a curious puzzle.

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