RESEARCH ARTICLE

The Seashells of an Iconic Public Artwork: Diversity and Provenance of the Mollusks of the Watts Towers

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The Watts Towers (WT), an iconic Los Angeles artwork created by Sabato Rodia in 1921–1954, is covered with mosaics whose elements include thousands of mollusk shells. Little is known about the diversity or sources of these shells. Here, we document the diversity of mollusk shells present in the WT and use data on their characteristics to make inferences about their provenance. We identified shells of 34 species, 24 of them bivalves (clams and their relatives) and 10 gastropods (snails). Almost all (29/34) of these species are native to southern California shorelines, especially those of bays and estuaries. Rodia could have accessed these sites on foot, by automobile, or by using the Red Car trolley system. Some of the bivalve shells bear drill holes made by naticid gastropods, suggesting that they were collected post-mortem, presumably after they had washed up on beaches. These observations are consistent with the sparse documentary evidence on the origin of the shells of the WT. This detailed information on the diversity of the seashells of the WT should be of utility to conservators, and of interest to scholars of and visitors to the WT.

Keywords: mollusk; seashell; Rodia; Watts Towers

Introduction

The Watts Towers (WT), also known as Nuestro Pueblo, or the Towers of Simon Rodia, is an assemblage of numerous interconnected structures built by Italian immigrant Sabato Rodia between 1921 and 1954, in the Watts area of Los Angeles. These include five major towers (two of which are ca. 30 meters tall), as well as structures later identified by conservators as a ship, a gazebo, a fountain, a barbeque, and an eight-foot-tall perimeter wall. The structures are built of steel elements (rods and pipes), which were wrapped with wire mesh and coated with a thin layer of mortar. Before the mortar set, Rodia made imprints of various objects as decorations, or partially embedded found objects such as fragments of bottles or dishes, or the shells of various mollusks, into the mortar. Before the mortar set, Rodia made imprints of various objects as decorations, or partially embedded found objects such as fragments of bottles or dishes, or the shells of various mollusks, into the mortar. In 1954, after more than 30 years of work on the structures, Rodia deeded the site to a neighbor and moved north to the San Francisco Bay Area. The subsequent dramatic history of the WT— which included a successful community campaign to block the City of Los Angeles’ demolition order in 1959— is documented in numerous sources (Whiteson 1989; Goldstone and Goldstone 1997; Herr 2014; Morgan 2014).

After 1959, when its existence became widely known, the WT was heralded as a masterpiece of intuitive engineering, architecture, and sculpture (Trillin 1965; Ward 1986; Goldstone and Goldstone 1997; Schrank 2009; Del Giudice 2014a). In 1963, it was declared a City of Los Angeles Historic-Cultural Monument, and listed on the U.S. National Register of Historic Places. In 1990, it was designated as both a California Historical Landmark and a U.S. National Historical Landmark. Though owned by the State of California, the WT is leased and controlled by the City of Los Angeles. Since 2010, the Los Angeles County Museum of Art (LACMA) has contracted with the City’s Department of Cultural Affairs to manage its preservation.

An essential element of the preservation of historic properties and public art such as the WT is thorough, detailed knowledge of the site and its structures. For example, in The Secretary of the Interior’s Standards for the Treatment of Historic Properties, Grimmer (2017) notes that a first step in preservation is ‘identifying […] character-defining features’. Such knowledge is critical to meet modern restoration standards as well. In cases where design elements must be repaired or replaced, the new material should ‘match the old in composition, design, color and texture’ (Grimmer 2017). Identification of the features of the WT has been ongoing since the 1960s, with a special focus on load-bearing characteristics in order to ensure the structures’ integrity in the face of the challenges posed by daily and seasonal thermal variation, intense seasonal winds, and earthquakes in southern California. Substantial work has also been carried out to identify some of the found...
objects embedded in the WT, in particular the fragments of ceramic tile, dishware, and soda bottles essential to Rodia’s pique assiette mosaics (Goldstone and Goldstone 1997; Silverman 2018).

Very little is known, however, about the found objects of biological origin that make up a striking and distinctive element of the WT mosaics: the seashells. Intact or (less commonly) fragments of mollusk shells are extremely abundant in the structures (Figure 1). Published estimates of their numbers include 7000 (A.P Goldstone 1990), 10,000 (Goldstone and Goldstone 1997), and even 75,000 (Langsner 1951), though the origins of these estimates are unclear. A summary of conservation work to date (B. Goldstone 1997) notes that as of May 1997, a total of 7723 seashells had been cleaned on various structures at the site. This report also notes that the cleaning work had not yet been completed on several major structures, all of which also include mollusk shells; thus, this estimate of 7723 should be viewed as a minimal estimate of the number of mollusk shells in the WT. The rough estimate of 10,000 shells made by Goldstone and Goldstone (1997) therefore appears reasonable.

For much of its preservation history, the seashells of the WT were explicitly treated as ‘generic’ ornaments (Ehrenkrantz Group Preservation Plan 1983, p. 188). Damaged or lost generic ornaments could ‘be replaced using newly obtained material’, though ‘every effort should be made to achieve color and overall texture and pattern match with the original.’ However, even a cursory examination of the seashells of the WT suggests that they are not ‘generic’ in any commonly understood sense. They include the shells of both snails and clams, for example, which are strikingly different in form. Within the clams (which make up the vast majority of the WT seashells), some types are tiny (ca. 1 cm length) and some are much larger. These are often arranged in type-specific arrays (see Figure 1). Perhaps for this reason, in a later version of the Conservation Handbook, B. Goldstone (1998) considered the seashells ‘specific’ ornaments, to be replaced only from the stockpile of original Rodia-collected materials. Despite this change in classification, there is still very little known about the diversity of seashells found in the WT, or their provenance.

Such information would be of utility both in the preservation and restoration of the WT, and in understanding its history and that of its surrounding environment. From the standpoint of conservation, knowledge of the types of shells present would allow adequate documentation of any future degradation or damage of the WT, and would permit repair with appropriate replacements. In terms of the history of the WT, it would be of interest to know where Rodia obtained the mollusk shells he used in the monument. Were the shells obtained locally, as Rodia suggested verbally? For instance, in 1962 ‘He described. . . how he picked up sea shells while walking along the beach from San Pedro to Long Beach with an old cement sack on his back’ (letter from Claudio Segre, p. 379 in Del Giudice 2014b), and many other authors have also stated this.

Figure 1: Mollusk shells on the Watts Towers. A. View from southeast of the exterior of the Watts Towers, showing the Center Tower (left), East Tower (middle), and one of the Ships spires (right). Mollusk shells are visible in the South Wall exterior; the two towers and the spire shown in the image also bear many mollusk shells. The Center Tower is about 30.3 m in height. B. Bivalve shells (mostly Chione and Chionista spp., with a few Argopecten ventricosus and Tivela stultorum) on the South Wall exterior panel between posts 20 and 21. C. A heart shape on the Ship formed by shells of Donax gouldi. D. Shells of Mytilus californianus embedded on South Wall interior, post 4. They are mounted with the interior of the shell facing the observer, which is unusual; most bivalve shells on the Watts Towers are mounted with the interior surface of the shell embedded in the mortar.
without reference to primary sources. Were they obtained as dead shells washed up on the beach as suggested by the quote above, or as live animals, or perhaps as waste from local kitchens? If the shells of species of mollusks that are not native to California appear in the WT, how are art historians and conservators to interpret them— as original ornaments Rodia obtained on his travels or as gifts, or perhaps as evidence of undocumented repairs made after Rodia stopped work? The answers to such questions will allow scholars to further analyze Rodia’s building practices, and also to compare the WT with other seashell-ornamented yard structures created in the same time period, such as vernacular Italian American yard shrines and hand-built roadside grottos (Stone and Zanzi 1993; Sciorra 2015).

On our first visit to the WT, we were struck by the number and diversity of molluscan ornaments present, and felt that a careful description of the shells would be of great use not only to conservators and scholars, but would also help casual visitors to appreciate that these are truly not ‘generic’ ornaments. Our goal in this study was to document the diversity and distribution of mollusk shells present in the WT, to provide a pictorial guide to the species present, and to make inferences about the provenance of the seashells based on their characteristics.

Methods
We visited the WT about a dozen times in the spring and summer of 2012, and again several more times in the summer of 2018. On visits, we closely observed shells throughout the site, including on both interior and exterior surfaces of the walls. We examined shells located up to ca. 3 m above ground level by eye, using a stepladder where necessary. We observed shells at higher elevations using binoculars. In this fashion, we assembled a species list of the shells present in the WT, identified to the lowest taxonomic level possible (usually species). In this report, we provide pictorial documentation of each identified taxon, and notes on their geographic distribution and habitats. Information on the biology of most bivalves is from McLean (1978), Haderlie and Abbott (1980), Coan et al. (2000), and Coan and Valenti-Scott (2012), and for gastropods, McLean (1978) and Abbott and Haderlie (1980). We also provide information on the locations of some shells in the WT, using a standard set of terminologies for the parts of the WT provided to us by the LACMA conservation team (Table 1; Figure 2).

Limitations in how we were able to observe shells inevitably led to several potential sources of error. Most importantly, almost all of the bivalve shells in the WT are embedded with their interior surfaces down (that is, embedded in the mortar), and thus invisible. This makes identification of some shells difficult, as two interior shell structures – hinge dentition, and muscle scars – are often diagnostic. Fortunately, many species can be definitively identified using external shell characters such as overall shape and the distribution of radial and commarginal shell elements (e.g. ribs or lamellae). Another limitation is that because we had a low elevation vantage point (at the most, ca. 3 m above ground level using a stepladder), we undoubtedly did not see some higher elevation shells that were embedded on sections of the WT not visible from our vantage point. Finally, because we observed high elevation shells from a distance using binoculars, we sometimes could not see their structural details clearly. These issues may have led us to underestimate the diversity of shells at the site.

We reasoned that knowledge of two aspects of the biology of the species occurring in the WT might allow us to make inferences about where the shells had been obtained. First, where possible, we categorized the mollusk shells occurring in the WT by the typical habitat occupied by that species in life. Habitat information was obtained from the references cited above.

Second, during our observations, we noted that numerous bivalve shells bore complete, beveled drill holes characteristic of predation by moon snails (naticid gastropods). Naticids bore holes only in living prey; a complete drill hole indicates successful predation. Presence of a complete drill hole is thus strong evidence that a given shell was obtained post-mortem. Further, biologists have sometimes estimated the naticid ‘drilling frequency’ in death assemblages’ of shells washed up on beaches (Vermeij 1980; Pruss et al. 2011). If the frequency of naticid drill holes in bivalve shells in the WT is similar to that in natural death assemblages, then it seems likely that the larger population of bivalve shells at the WT was collected as post-mortem beach drift. To estimate drilling frequency in a subsample of bivalve shells on the WT, we identified three panels of the South Wall that bore large numbers of shells of Chione and Chionista spp. (interior panels between posts 19–20 and 20–21, and exterior panel between posts 2–3), and photographed these. We inspected each shell in these images for naticid drill holes, later returning to the South Wall to confirm our identifications of drilled shells. We calculated drilling frequency as the number of drilled valves divided by half the number of total valves (Pruss et al. 2011).

Table 1: Main structures of the Watts Towers examined in this study. The locations of each structure can be found in Figure 2. Note that the House was largely destroyed by fire around 1955. Its chimney, which includes numerous shells, remains mostly intact.

| Walls                          | Internal Structures |
|-------------------------------|---------------------|
| South Wall (exterior)         | House (chimney)     |
| South Wall (interior, incl. Pinnacles) | A Tower           |
| North Wall (exterior)         | B Tower             |
| North Wall (interior, incl. Barbeque & Fountain) | Gazebo           |
|                               | West Tower          |
|                               | Center Tower        |
|                               | East Tower          |
|                               | Ship                |
Results

We identified the shells of 34 species of mollusks embedded in the WT (Table 2; Appendix). All of the structures listed in Table 1 bear mollusk shells. The majority of the species (24) are bivalves (clams and their relatives), and the remainder are gastropods (snails). As noted above, these are minimum estimates because for most bivalve shells we could not examine diagnostic characters of the interior shell surface, and because we were not able to examine all high elevation shells carefully. Further, many shells are already heavily damaged such that all the shell material is missing except for the rim, embedded in mortar. Even with this caveat, the molluscan fauna we observed on the WT is strikingly diverse. Though we did not quantify the numbers of each type of shell present in the WT, our observations suggest that the most common bivalve shells in the WT belong to *Argopecten ventricosus*, *Chione californiensis*, and *Chione undatella* (Figure 3A–D). Species of bivalves that appear as singletons include *Crassadoma gigantea* (South Wall interior panel between posts 19 and 20), *Crassostrea gigas* (South Wall exterior panel between posts 3 and 4), *Lithophaga plumula* (North Wall interior panel between posts 13 and 14), *Macoma nasuta* (Center Tower base), *Panocea generosa* (east-most spire of the Ship), *Seemel decisa* (North Wall interior panel between posts 9 and 10), *Trachycardium quadragenarium* (South Wall interior panel between posts 9 and 10), and *Tresus nutalli* (North Wall interior panel between posts 9 and 10). Of the 24 species of bivalves present in the WT, all but three are native to southern California: the Pacific oyster *Crassostrea gigas*, the elegant dosinia *Dosinia elegans*, and the Washington butterclam *Saxidomus gigantea*.

Gastropod shells are relatively uncommon at the site, with the most common species present being *Haliothis* sp. (Figure 3E and F). Shells of *Haliothis* sp. occur almost exclusively as fragments, with the interior surface of the shell facing the observer. The exceptions are several intact shells on the South Wall exterior, over the Front Gate, and several more over the House front door. The intact shells are those of *H. cracherodii*; the fragments may be those of *H. cracherodii*, or might be from the shells of other species. Six of the ten species of gastropods present occur as singletons: *Crosstata* sp. (South Wall exterior post 11), *Cerithideopsis californica* (South Wall exterior panel between posts 15 and 16), *Lobatus gigas* (South Wall exterior panel between posts 25 and 26), *Nassarius fossatus* (House chimney). Of the ten species of gastropods present in the WT, only two are clearly not native to southern California: the Florida crown conch *Melongena corona*, and the queen conch *Lobatus gigas*. Because it is not identified to species, we cannot determine if the single *Crosstata* sp. shell present is native to southern California.

We categorized the mollusk shells occurring in the WT by the typical habitat occupied by that species in life (Table 3). Nineteen of the 34 species we identified (ca. 56%) are typically found in bays and estuaries. Habitats like this in southern California include Alamitos Bay, Anaheim Bay, and Newport Bay. The 19 bay and estuary species include three of the most common bivalves in the WT: *Argopecten ventricosus*, *Chione californiensis*, and *C. undatella*. Ten more species (ca. 29%) typically occur in rocky habitats on wave-exposed coasts, like those found in the intertidal zone on the Palos Verde Peninsula. Five species (ca. 15%) typically occur in sand or gravel habitats on wave-exposed coasts; one of these, *Tivela stultorum*, is one of the most common bivalves in the WT.

In order to estimate the frequency of drilling predation by naticid gastropods on the WT bivalves, we examined a total of 358 shells of *Chione* and *Chionista* spp. from three panels of the South Wall. Of these, 14 shells bore naticid drill holes (Figure 4). The drilling frequency in this sample was 0.078.
Discussion

Seashells are a striking and numerically abundant component of the decoration of the WT, and are present on all major WT structures. Despite this, until now they have been treated rather generically. They are almost always referred to only as 'seashells,' with no suggestion that there might be a variety of types of seashells present. This is perhaps not surprising, since mollusk taxonomy is likely outside of the range of knowledge of the art critics, art historians, and conservators who make up the majority of WT scholars. Further, the art world reception of the WT has centered on the qualities that make it a work of assemblage sculpture—a sculpture made out of discarded human-made objects (Seitz 1963). This treatment of the seashells of the WT is clearly inadequate in at least one sense: it is not very helpful in efforts to describe, preserve, or restore the structures.

Table 2: Types of molluscan shells embedded in mortar at the Watts Towers. Most are identified to the species level, but a few could only be identified to the genus or family levels. Asterisks (*) indicated that the species is not native to southern California.

| Bivalves                      | Gastropods                      |
|-------------------------------|---------------------------------|
| Amiantis callosa              | Macoma secta                    | Cerithideopsis californica     |
| Argopecten ventricosus        | Mytilus californianus           | Crossata sp.                   |
| Chama exogyra                 | Saproplectus sp.                | Haliothis cracherodii          |
| Chione californiensis         | Chama sp.                       | Megasura undosa                |
| Chione undatella              | Psamnotre numata                | Megathura crenulata            |
| Chionistra fluctifraga       | *Saxidomus gigantea             | *Melongena corona              |
| Crassodoma gigantea          | Saxidomus nutallii              | Nassarius fossatus             |
| *Crassostrea gigas           | Semele decisa                   | Neverita reclusiana            |
| Donax gouldi                 | Tagelus californianus           | *Lobatus gigas                 |
| *Dosinia elegans             | Tivela stultorum                | Thylacodes squamigerus         |
| Lithophaga plumula           | Trachycardium quadragenarium    |                             |
| Macoma nasuta                | Tresus nutallii                 |                             |

Figure 3: Exemplars of the most common mollusk shells on the Watts Towers. A. Argopecten ventricosus (Chimney). B. Chione californiensis (west side of A Tower). C. Chione undatella (west side of A Tower). D. Tivela stultorum (South Wall exterior between posts 19 and 20). E. Fragments of the shell of Haliothis sp. (Front Gate interior), with shell interior facing the observer. F. Intact shell of Haliothis cracherodii (House entrance); while fragments of the shell of Haliothis sp. are extremely common, intact shells like this one are quite rare.
We report here that the seashells on the WT comprise at least 34 species in two major classes, the bivalves and the gastropods (Table 2). We provide a detailed pictorial guide to these species (Appendix), with the primary aim of assisting conservators in identifying exactly what species are present in various parts of the structures. We also use information about the biology of the species and specimens present to corroborate sparse information from other sources about topics, such as where and how Rodia obtained the shells he embedded in the WT.

Our results represent a dramatic increase in the resolution of knowledge of the WT’s seashells. Despite this, we would like to emphasize that this is still a significant gap in knowledge.

**Table 3:** Habitat types in which the molluscan species found at the Watts Tower typically occupy in life. Species that are not native to southern California are indicated with an asterisk (*).

| Bays or estuaries                  | Exposed coast sand or gravel | Exposed coast rock          |
|------------------------------------|------------------------------|-----------------------------|
| Argopecten ventricosus (Bivalvia)  | Amiantis callosa (Bivalvia)  | Chama exoaphyra (Bivalvia)  |
| Chione californiensis (Bivalvia)   | Donax gouldi (Bivalvia)      | Crassadoma gigantea (Bivalvia) |
| Chione undatella (Bivalvia)        | Psammotreta obesa (Bivalvia) | Lithophaga plumula (Bivalvia) |
| Chionista fluctifraga (Bivalvia)   | Semele decisa (Bivalvia)     | Mytilus californianus (Bivalvia) |
| *Crassostrea gigas (Bivalvia)      | Tivela stultorum (Bivalvia)  | Penitella sp. (Bivalvia)    |
| *Dosinia elegans (Bivalvia)        |                             | Crossata sp. (Gastropoda)   |
| Macoma nasuta (Bivalvia)           |                              | Haliotis cracherodii (Gastropoda) |
| Macoma secta (Bivalvia)            |                              | Megastraea undosa (Gastropoda) |
| Panopea generosa (Bivalvia)        |                              | Megathura crenulata (Gastropoda) |
| *Saxidomus gigantea (Bivalvia)     |                              | Thylacodes squamigerus (Gastropoda) |
| Saxidomus nuttalli (Bivalvia)      |                              |                             |
| Tagelus Californianus (Bivalvia)   |                              |                             |
| Trachycardium quadrangenarium (Bivalvia) |                          |                             |
| Tresus nuttalli (Bivalvia)         |                              |                             |
| Cerithideopsis californica (Gastropoda) |                   |                             |
| *Melongena corona (Gastropoda)     |                              |                             |
| Nassarius fossatus (Gastropoda)    |                              |                             |
| Neverita reclusiana (Gastropoda)   |                              |                             |
| *Lobatus gigas (Gastropoda)        |                              |                             |

**Figure 4:** Examples of moon snail (naticid) drill holes in the shells of bivalves on the Watts Towers. **A.** Moon snail drill hole in valve of *Chione undatella* (South Wall exterior between posts 3 and 4). **B.** Moon snail drill hole in valve of *Chionista fluctifraga* (South Wall exterior, post 16). In both cases, drill holes are complete— that is, they completely penetrate the shell. This is strongly suggestive of successful predation, which indicates that these particular shells were collected post-mortem.
additional work is needed. An important next step is to map and identify every shell on the WT. This would yield an exact number of shells on the structure, allow art historians to describe their distribution patterns on particular sub-elements, and provide baseline data that could be reexamined over time to identify losses of shells due to weathering, earthquakes, or other types of damage. Accomplishing this task would be labor-intensive, but not conceptually challenging. LACMA conservators have made high-resolution images of all surfaces of the WT. Identification of shells should start with the careful labeling and analysis of shells on these images, followed by ground truthing of at least a subset of those identifications by direct examination of shells on the structures. These data would be extremely helpful in the preservation of the structures.

The sources of the seashells of Watts Towers

A more detailed knowledge of the diversity of molluscan shells present on the WT and of their condition allows us to independently test conclusions derived from other sources about the provenance of the seashells. The best evidence we are aware of on the provenance of the seashells in the WT are several statements made long after construction by Rodia himself. By far the most direct of these is described in a letter from Claudio Segre in 1962, who reported that in a conversation, Rodia had described ‘how he picked up sea shells while walking along the beach from San Pedro to Long Beach with an old cement sack on his back’ (Del Giudice 2014b, p. 379). It is not clear how much faith we should put in that report, though, as Rodia was well known for ‘varying his storytelling according to mood and audience’ (Del Giudice 2014a). Our data allow independent tests of two predictions derived from Rodia’s statement.

First, if Rodia collected seashells in southern California, the seashells present in the WT should be from species native to southern California, or known to have been introduced and established in southern California in the period in which Rodia was building the WT. Our data are nearly perfectly consistent with that prediction: almost all of the species of mollusks whose shells can be found on the WT (29 of 34 we identified) are native to southern California. Three of the five exceptions to this pattern (the bivalve *Dosinia elegans* and the gastropods *Melongena cracherodii* and *Argopecten ventricosus*, *Chione californiensis*, and *C. undatella*) typically inhabit relatively wave-protected habitats like bays and estuaries, for example the Los Angeles/Long Beach Harbor areas, Alamitos Bay in Long Beach, and Anaheim Bay in Seal Beach. Rodia was very likely familiar with Long Beach-area habitats, as he had lived in that city for around 3 years prior to purchasing his lot in Watts in 1921 (Whiteson 1989), and during that time built several decorative structures that also included seashells (Goldstone and Goldstone 1997). Two other fairly common bivalves—*Donax gouldi* and *Tivela stultorum*—inhabit wave-exposed sandy beaches, like those of the Santa Monica Bay beach cities to the west of Watts, or Long Beach, Sunset Beach, and Huntington Beach to the south. Finally, a few species (e.g. *Haliotis cracherodii* and *Mytilus californianus*) are characteristic of wave-exposed rocky habitats like those of the rocky intertidal zone on the Palos Verde Peninsula.

Rodia could have accessed these locations in at least four ways. First, the WT was located at the junction of three major ‘Pacific Electric’ (also known as ‘Red Car’) rail lines in Pacific Electric’s Southern District (all rail line details below from Walker 1975), and only ca. 600 m from the Watts Station, which served all three lines. Of the three lines adjacent to Rodia’s property, two led directly to the coast. The Redondo via Gardena Line delivered passengers from Watts Station west to the southern portion of Santa Monica Bay, with its exposed sandy beaches and rocky intertidal zone on the north side of the Palos Verde Peninsula. The Long Beach Line delivered passengers to the south to Long Beach, situated on the central portion of San Pedro Bay. Before reaching Long Beach, at Dominguez Junction, the San Pedro via Dominguez Line split off to the west to deliver passengers to San Pedro, on the west side of San Pedro Bay; here there was access to more rocky intertidal areas. Passengers who stayed on the Long Beach Line all the way to Long Beach (with its exposed sandy beaches, as well as protected Alamitos Bay) could then continue along the coast to Newport Bay, on the Newport-Balboa Line. This last line provided access to wave-exposed sandy beaches, as well as the protected
habitats of Anaheim Bay, Bolsa Chica, and Newport Bay. All of these lines were built and in operation at least a decade before Rodia started building the WT in 1921. The Long Beach and San Pedro via Dominguez Lines operated into the late 1950s, but service stopped on the Redondo via Gardena and Newport-Balboa Lines in the early 1940s. Thus for at least the first ca. 20 years of the WT construction, it would have been very easy for Rodia to access all three of the major types of habitat by Red Car, and he could access Long Beach’s exposed and protected beaches via Red Car throughout his entire time in Watts.

Second, Rodia might have driven himself to the shore in an automobile. Numerous literature reports state that Rodia owned at least one automobile after 1927. Specifically, these accounts state that he owned a 1927 Hudson, in which he had installed a fire siren used to facilitate his passage through traffic. However, the accounts continue by noting that at some point (year unspecified) he became so worried that the police might cite him for illegal use of such a siren that he dug a large hole adjacent to his property and buried the entire vehicle (Whitson 1989; Goldstone and Goldstone 1997; Umberger 2007; transcript of 1963 interview with Rodia’s neighbors in Del Giudice 2014b, pp. 412–413). This story seems somewhat fantastical (why would Rodia bury the entire vehicle when he could have simply removed the siren and kept the vehicle, or sold it?), but several accounts note that indeed, a buried car was found adjacent to the WT in 1998 (Landler and Byer 2006, 44 min 50 sec; Umberger 2007). Rodia himself suggested that after the Hudson he owned another vehicle, as well: ‘Hudson, that was the first one make. The second one was a Dodge’ (transcript of 1960 interview with Nicholas King in Del Giudice 2014b, p. 420). Thus, Rodia may have had access to vehicles for much of the time he was working on the structures (1921–1954).

Third, he might have simply walked to the seashore from Watts. Though this seems unnecessary given his immediate access to inexpensive public transportation, Rodia did state several times that he walked long distances to obtain materials. For example, in 1960 he told Mae Babitz and Jeanne Morgan ‘Walking, 20, 40 miles from Redondo Beach, walking everywhere getting things [...]’ (Del Giudice 2014b, p. 366), and Trillin (1965) quotes Rodia as saying ‘When it was Saturday and holidays, I walk from the towers to San Pedro sometime. I had a cement bag in my hand. I’d bend down, put in sack.’

Finally, it is of course possible that others collected some or all of the shells that Rodia used in the WT, and that they were gifted to him or purchased by him. Some statements in the literature suggest that Rodia paid or traded with neighborhood children for decorative materials, for example (National Register of Historic Places Registration Form 1990).

The facts that almost all of the seashells found in the WT are those of species that could be easily found in southern California habitats, and that Rodia had easy access to all of these habitats, are consistent with the traditional account of the provenance of the seashells: Rodia very likely obtained most shells used in the structures from southern California sites not very distant from the WT.

A second prediction based on Rodia’s statements is that if he collected seashells from the beach, he was likely collecting shells that had washed onshore after a natural death. One line of evidence suggests that at least some species were collected post-mortem. Our examination of a sample of shells of *Chione* and *Chionista* spp. in the WT revealed that a fairly high percentage of shells had drill holes characteristic of predation by moon snails (natid gastropods). These shells, at the very least, were collected after the clam had died. The drilling frequency estimated from this sample was 0.078, which is within the range of such frequencies (0.022–0.75) reported from beach-collected ‘death assemblages’ of shells from various parts of the world (Vermeij 1980; Morton & Knapp 2004; Pruss et al. 2011). These observations are consistent with the hypothesis that shells of at least *Chione* and *Chionista* spp. found in the WT were collected from the population of dead shells on southern California beaches.

For one type of gastropod that is fairly abundant in the WT— the abalone *Haliotis sp.— an alternative hypothesis may be more reasonable. The six intact abalone shells on the WT are those of *H. cracherodii*, the black abalone. We could not identify fragments of abalone shell to species; these might be from *H. cracherodii* or other species, like the green abalone, *H. fulgens*. Black abalone, in particular, were extremely abundant in the southern California rocky intertidal zone in the early part of the 20th century. Even as late as the 1960s, they were ‘usually found in great numbers crowded close together and at times stacked two or three on top of each other’ (Cox 1962). Because black and green abalone were found in the intertidal zone, they were more easily accessible to human fishers than other southern California species of abalone, and indeed, huge numbers were harvested for food. This left many shells available for shell collectors. There is nothing in the documentary record about where Rodia obtained the abalone shells in the WT, but it seems very possible that he received them after they had been collected alive and eaten. It is also possible, of course, that he collected dead shells from the rocky intertidal zone.

**What does the presence of shells of non-indigenous species in Watts Towers mean?**

The shells of only five of 34 species we identified on the WT belong to species that are not native to California. Three of these (the bivalve *Crassostrea gigas*, and the gastropods *Lobatus gigas* and *Melongena coronata*) occur as singletons; one (the bivalve *Saxidomus gigantea*) occurs as only two shells; and the fifth, the bivalve *Dosinia elegans*, occurs in groups in at least two parts of the WT: the East Gate of the South Wall exterior, and on the outer supports of the West Tower (near the ground, on the NE side of the tower). As noted above, only one of these species (*C. gigas*) has ever been reported as introduced or established to California waters. Three of the others are west Atlantic in range, and *S. gigantea* occurs on the west coast of the U.S. from Monterey Bay to the north. One interpretation of the presence of the shells on these five non-indigenous species in the WT is that Rodia himself somehow obtained...
the shells (possible scenarios for this are discussed above) and embedded them in the mortar of the WT itself.

There is an alternative hypothesis, however. Substantial restoration work has been done on the WT since the 1960s. In the early years of restoration, much work was not documented carefully, or at all (Whitson 1989). Further, at least in the period from 1983–1998, sea-shells were considered ‘generic’ ornaments, and the Ehrenkranz Preservation Plan (1983) permitted conservators to replace such generic ornaments ‘using newly obtained material.’ Thus, it is entirely possible that some of the seashells present on the WT are not original. Given the limited documentation of early ‘repairs’ to the WT, it may be difficult to identify non-original seashells. One possibility worth considering, however, is that the shells of non-indigenous species present in the monument are more likely to have been placed there after the fact than those of native species. The prime suspect here is the west Atlantic clam Dosinia elegans, groups of which are present on the WT in at least two areas. It is possible that these were purchased by early conservators to replace decoration in areas of the structures that had suffered damage to original ornamentation. Further work—especially comparison of the current seashell fauna of specific sculptures of the WT with that observed in historical photographs—is needed to explore this possibility.

**Implications for the preservation of Watts Towers**

Detailed knowledge of the identities of the seashells of the WT, such as that we provide here, is a step toward making sensitive restoration of this sculpture possible. Such restoration might eventually be needed, as the seashells of the WT are vulnerable to damage and loss, as clearly indicated by the many shells that are already so heavily damaged that most of the shell is missing, with only the rim embedded in mortar remaining. An important next step will be to map and identify as many individual shells as possible, so that if eventually needed they can be replaced with conspecific shells from southern California habitats.

One additional conservation-related concern is that even if restoration of ornaments becomes a high-priority goal, it may now be difficult to obtain the appropriate replacement shells from some southern California habitats. The WT includes shells from species that typically occupy at least three very distinct habitats (Table 3). Two of these—exposed sandy beaches, and exposed rocky habitat—are rarely affected by invasions of non-indigenous species, and the species from these habitats found in the WT are mostly still common in these habitats today. One specific exception is the abalone, Haliotis sp., from the rocky intertidal zone. As noted above, abalone, especially black abalone, were extremely abundant in the period in which Rodia was working in Watts, but southern California populations of black abalone declined precipitously in the late 1980s and have never recovered (Miller and Lawrenz-Miller 1993).

Molluscan fauna of the third habitat, bays and estuaries, has changed very dramatically since the 1950s in part because of the introduction, establishment, and population growth of non-indigenous species. This may have had negative effects on the abundance of native bivalves. For example, Rodia seems likely to have collected shells from Alamitos Bay in Long Beach, a typical bay habitat that in his time probably contained large populations of Chione spp. and Argopecten ventricosus, some of the most common seashells present in the WT. However, a 2009 survey of a part of Alamitos Bay, Colorado Lagoon, showed that nearly 90% of the bivalve individuals then present in the lagoon were non-indigenous species. The vast majority of these bivalves were individuals of Venerupis philippinarum, a species that to the best of our knowledge was introduced into southern California in 1953 (Carlton 1979; Burnaford et al. 2011), and began a full invasion in the 1990s. The absence of V. philippinarum shells from the WT is consistent with that inference. Native bivalves common in the WT, while still present in Colorado Lagoon, are now relatively rare at that site. For example, shells of the two Chione spp. are extremely common in the WT, but as of 2009, Chione spp. made up only ~8.5% of the living clams present in Colorado Lagoon (88% of the living clams were V. philippinarum).

Thus, comparison of the WT fauna with that of the modern fauna is consistent with other evidence that since the 1950s there have been dramatic changes in the bivalve fauna of southern California bays and estuaries. This is of interest to biologists, of course, but it is also important for WT conservators to be aware of. Because of these shifts in the bivalve communities in southern California bays and estuaries since the 1950s, replacing damaged bivalve shells on the WT with locally collected bivalve must be done carefully; in bays and estuaries, at least, the majority of shells now available are not those of species available when Rodia was building the towers.

The National Register of Historic Places Registration Form for the WT (1990) notes that ‘not only are the Towers acclaimed as a work of art and a marvel of engineering and structure, but they also vividly represent 20th century American material culture.’ The second clause of this statement focuses on the WT ornaments that are non-biological in origin, a common oversight in the literature on the structure. We hope that this study makes clear that the WT also vividly represents local molluscan communities from the early 20th century, and that detailed information on the diversity of its seashells is of utility to conservators and of interest to scholars of and visitors to the WT.

**Additional File**

The additional file for this article can be found as follows:

- Appendix. Pictorial Guide to the Mollusks of the Watts Towers. DOI: https://doi.org/10.5334/jcns.177.s1

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Competing Interests
The authors have no competing interests to declare.

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