

## Intertidal Survey at the McKee Center for Environmental Conservation, Research, and Education

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### Description of McKee Intertidal Zone

McKee Center is bounded on the Gulf of California by nearly 100 meters of intertidal zone (Fig. 1). The beach is composed of sand covered by rock cobbles varying in size from a few cm to tens of cm, with small “points” extending seaward at three places spaced ~50 m from one another (Fig. 2). The adjacent seafloor is largely sand, but these rocky areas support considerable underwater algal growth. Casual examination at low tide in June 2024 revealed an abundance of invertebrates under and around rocks, especially echinoderms (Fig. 3 -- sea cucumbers, large brittle stars, *Heliaster* sunstars, and urchins) and molluscs (many chitons, large and small snails). Colonies of coral (*Porites*), zoanthid anemones (Fig. 4), and large feather duster worms (*Spriobranthus giganteus*) were also abundant. Sandy areas between rocks featured burrowing anemones, as well as large crabs and pistol shrimp in burrows.



Figure 1. Aerial view of McKee shoreline with areas of rock. Survey sites are indicated.



Figure 2. Rocky beach at low tide with the three small points that were surveyed.



Figure 3. Echinoderms under an overturned rock.



Figure 4. Zoanthid anemones and sponge.

Despite the relatively small size of these points, invertebrate diversity is quite high. This feature, and the relative ease at which the intertidal can be explored, make this site an attractive location for education and research efforts focused on rocky intertidal communities. Although the points of the McKee intertidal are very close together, it appears that the community of organisms at each point are somewhat different. For example, numerous colonies of zoanthid anemones and sponges were found at Points 2 and 3 but not at Point 1. Point 1 is at the opening of the small estero, and tidal exchange appears to have deposited more sediment here than at the other points. Biological and physical differences between the points could thus provide the basis for educational field and monitoring programs that compare community composition with physical features such as rock size, sedimentation, and freshwater influence.

Location of the three points are:

Point 1 (estero): 27.198791° N, 112.196951° W

Point 2: 27.199520° N, 112.197824° W

Point 3: 27.2000578° N, 112.199372°

### **Intertidal surveys of McKee**

A preliminary brief survey of biodiversity of the McKee intertidal zone was carried out by 3 SURMAR individuals (W. Gilly, U. Markaida, and P. Zambrano) on June 19 and 24, 2024. Twenty-seven invertebrate species were found and one fish:

#### **Annelids:**

*Spriobranchnus giganteus* (tube worm)

Flatworm

#### **Cnidarians:**

*Porites panamensis* (coral)

Large solitary anemones

*Pachycerianthus insigis* (burrowing anemone)

*Palythoa ignota* (zoanthid anemone)

#### **Arthropods:**

*Eriphia squamata* (crab)

Porcelain crab

*Naevius vivesi* (ghost shrimp)

*Ligia occidentalis* (isopod)

*Cthamalus anisopoma* (barnacle)

*Tetraclita stalactifera* (barnacle)

#### **Molluscs:**

*Neorapana tuberculata* (snail)

*Littorina aspera* (snail)

*Nerita funiculata* (snail)

*Nerita scabricosta* (snail)

*Mitrella guttata* (snail)

*Turbo* sp. (snail)

*Chiton virgulatus* (chiton)

*Cerithidea* sp. (snail)

*Lottia atrada* (limpet)

*Saccostrea palmuta* (bivalve)

*Chama mexicana* (bivalve)

#### **Echinoderms:**

*Heliaster kubiniji* (sea star)

*Nidorellia armata* (sea star)

*Echinometra vanbrunti* (sea urchin)

*Holothuria lubrica* (sea cucumber)

*Ophiocoma aethiops* (brittle stars)

*Ophiocoma alexandrii* (brittle star)

#### **Chordates:**

*Gobiesox maeandricus* (clingfish)

This initial assessment was followed up in 2025 using a new method developed during the 2025 *Western Flyer* expedition to the Gulf of California for carrying out intertidal surveys to assess biodiversity at any location. In this approach, we designated the species (or types) of common intertidal invertebrates in the central and southern Gulf of California based on 20 years of surveys. This work was based on enumerating all individuals of every species encountered on marked transects at specified rocky sites, and over the years this field experience revealed what species were most likely to be encountered. During 10 years of biannual surveys of four rocky intertidal sites in the Santa Rosalia area, a standardized field-sampling sheet was adopted for 56 common species (or types). To increase the utility of this list for other areas and to accommodate non-rocky substrate, particularly sand, this number was increased to 82 core species/types (Table 1). Several taxa were omitted based on extreme difficulty in identification (sponges, bryozoans, copepods, tunicates), even though those these groups may be present at most sites. Several other types infrequently encountered were also omitted (lobster, octopus).

Most of the 82 “Core” species or animal types can be identified in the field by non-experts and can be checked as they are discovered, and Field Guides that included close-up photos of all organisms listed in Table 1 were prepared to assist with identification. Species of certain animal types that are more difficult to identify (and/or less common) have been incorporated into “Other” groupings, e.g. “Other Snails”. In these cases, notes must be taken in the field as to description and the best guess at identification to avoid counting a given Other entry more than once. In two cases (Nemertean, Sipunculid), the Other group is simply included with the indicated species. Final scoring for each site was computed in two ways: 1) the “Core” sum of the number of entries included in the 82 “Core” categories, with a single entry for any Other category, and 2) the sum of the corresponding Other entries minus 1 (which was included in the Core sum). The sum of Core plus Other entries defines the “Overall Total.”

This method was used to survey the intertidal at McKee on the morning of May 2, 2025. Low tide (-21 cm) occurred at 9:56 AM. The original observers at this site led three groups of ITESME students (4-6 per group), with each group surveying one of the three points (Gilly, Point 1; Zambrano, Point 2; Markaida, Point 3). None of the students had any formal training in marine biology or intertidal field work. Overall results tabulated across the three groups are indicated in Table 1. A score of 1 indicates that a Core species or type was found. An added “+” entry gives the number of additional other types found for that category. A total of 38 Core types were thus identified plus 13 additional Other types, for an overall total of 51. Results of the individual three groups were comparable with one another (Point 1 = 32 +8; Point 2 = 25 + 0; Point 3 = 38+13).

### **Discussion and Summary**

An overall total of 51 types of invertebrates found during the McKee survey indicates that this site is surprisingly diverse in comparison to other sites surveyed with the same method a few weeks earlier. Using the method described here during operations of the *Western Flyer* over April 16-24, 2025, Gilly led surveys by 12-25 non-specialist observers at 7 sites distributed over a large geographic area. Overall totals ranged from 25 (20+5) at San Lucas Cove to 59 (46+13) at Agua Verde. Several sites surveyed during this period included some that were difficult to access and have probably been influenced by human activity to a relatively minor extent -- Punta Trinidad (42+14=56), Puerto Refugio (36+12=48), and Punta Marcial (40+7=47). Thus, the McKee total of 51 is at the high end of these *Western Flyer* surveys. An overall total of 25 for San Lucas Cove is particularly relevant, because the area surveyed was small rocks on sandy substrate along the outer shore of the lagoon, a habitat very similar to that at McKee and only several km distant.

McKee is thus an unusually diverse site that is exceptionally easy to access and study. There are no large, slippery rocks, and simply walking on rocky beach at low tide yields a wide variety of organisms that are of interest to both students and researchers. Echinoderms are especially abundant, and the large colonies of zoanthid anemones are not common elsewhere in the Santa Rosalia area. The site has great potential for education and research activities.

Cnidarians	Anemone-Small, clustering	1	Bivalves	<i>Brachidontes</i> (%)		
	Aneomone -Large, solitary	1		<i>Chama</i> sp.	1	
	<i>Pachyeriantus</i> -burrowing			<i>Saccostrea palmuta</i>	1	
	Zoanthid- <i>Paylthoa</i> , <i>Zoanthus</i>	1		<i>Mytella guaynensis</i>		
	Coral - <i>Porites</i> sp.			<i>Modiolus capax</i>		
	Hydroids			<i>Lithophaga aristata</i> sp.		
Flatworms	Large	1+1			Pearl oyster	
Nemerteans	<i>Baseodiscus mexicanus</i>				Other bivalve	1+2
Sipunculids	<i>Pahscolosoma</i> , <i>Sipunculus</i> sp			Sea slugs	Sea slug, bubble shells	1
Annelids	Hard, <i>Spriobranchnus giganteus</i>	1+1		Chitons	<i>Chiton virgulatus</i>	1
	Tube-worm, large, soft	1	Other chiton			
	Unspecified sm. tube worm		Barnacles	<i>Tetraclita</i>		
	<i>Eurythoe complanata</i> , fireworm			<i>Chthamalus</i> (%)	1	
	Other free worm	1+1		Other large ( <i>Polycipes</i> )		
Limpets	<i>Lottia atrata</i> , large rough		Isopods,etc	<i>Ligia occidentalis</i>	1	
	Small rough (<1cm)	1		Other isopod or amphipod		
	Smooth (>1 cm)		Crabs	<i>Clibanarius</i> , <i>Calcinus</i> sp (Hermit )	1	
	Small smooth (<1cm)			<i>Grapsus grapsus</i>	1	
	<i>Siphonaria maura</i> , pulmonate limpet	1		<i>Eriphia squamata</i> - crab in hole	1	
	<i>Diadora</i> sp (keyhole limpet)			<i>Callinectes bellicosus</i>		
		Other crab		1+3		
		Snapping, pistol shrimp, tidepool shrimp		1+3		
Snails	<i>Thais biserialis</i>	1	Stars	<i>Phataria unifasciallis</i>		
	<i>Vasula (Thais) speciosa</i>	1		<i>Pharia pyramidata</i>		
	<i>Neoporana tuberculata</i>			<i>Heliaster kubiniji</i>	1	
	<i>Phyllonotus erythrosomus</i> (Murex)			<i>Nidorellia armata</i>		
	<i>Plicopurpura pansa</i>			<i>Mithrodia bradleyi</i>		
	<i>Pascula (Morula) ferruginosa</i>			Other sea star		
	<i>Altrimira (Mitra) sp</i>			<i>Ophiocoma aethiops</i>	1	
	<i>Mitrella guttata</i>	1		<i>Ophiocoma alexandri</i>	1	
	<i>Columbella fucata</i> sp.			<i>Ophionereis annulata</i>	1	
	<i>Conus nux</i>			Other brittle star		
	<i>Conus princeps</i>		Urchins	<i>Echinometra vanbrunti</i>	1	
	<i>Conus brunneus</i>			<i>Eucidaris thoursii</i>	1	
	<i>Conus purpurascens</i>			<i>Tripneustes depressus</i>		
	<i>Echinolittorinna modesta</i>			Long spined ( <i>Diadema</i> , <i>Centrostephanus</i> )		
	<i>Echinolittorinna aspera</i>	1		Other urchin, heart urchin, sand dollar		
	<i>Echinolittorina albicarinata</i> sp. (%)	1		Cucumbers	<i>Holothuria lubrica</i> sp.	1
	<i>Nerita scabricosta</i>	1	<i>Euapta godeffroyi</i>			
	<i>Nerita funiculate</i>	1	<i>Isotichopus fuscus</i>			
	Other snail	1+1	Other cucumber		1	
	Vermetids	<i>Serpulorbis margaritceus</i>				
Other vermitid		1+1				

Table 1. Field sheet used to survey the 82 Core species (types) of intertidal invertebrates. Numbers identified in the McKee survey of May 2025 are indicated for each type of organism.