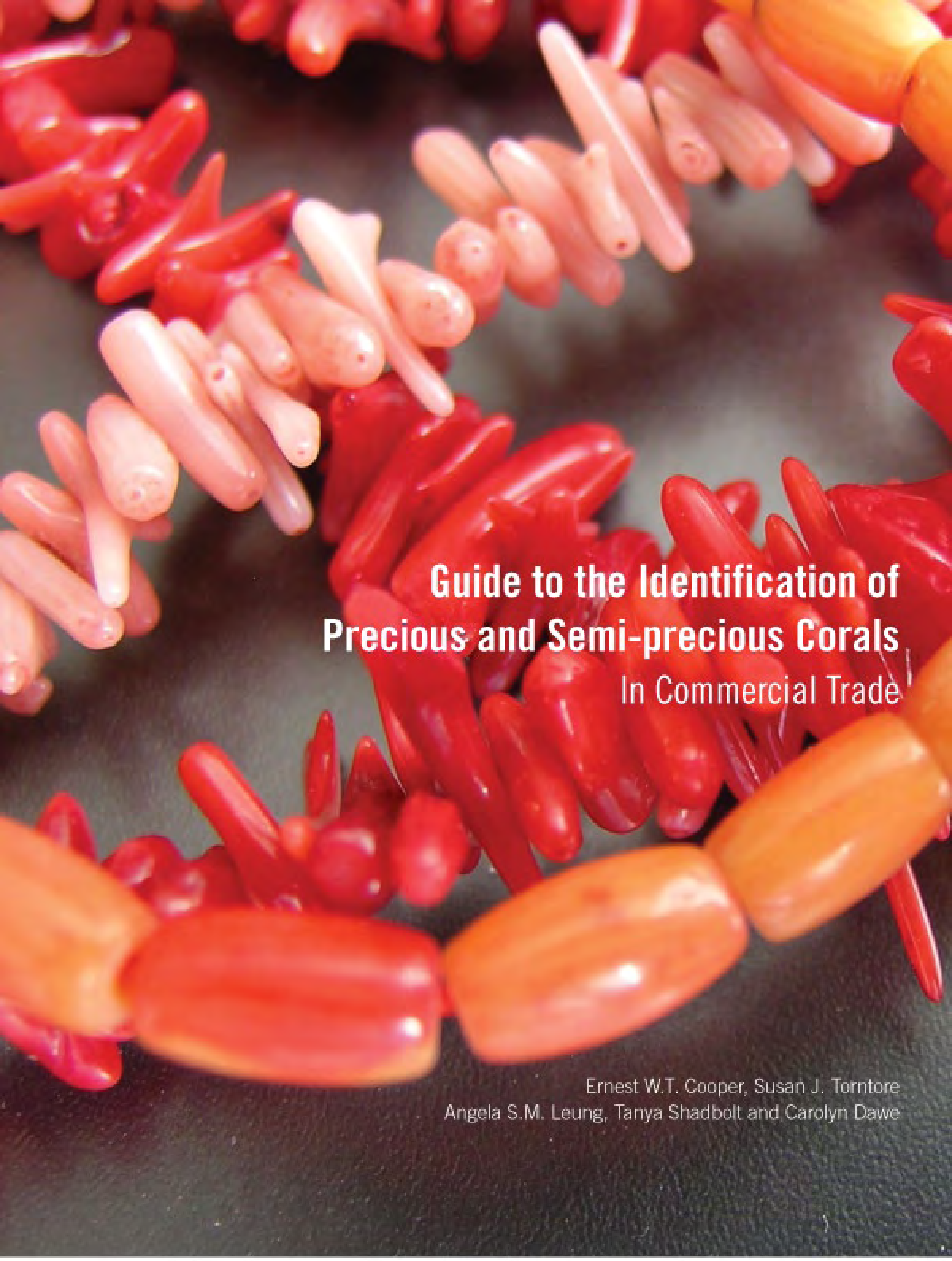

Guide to the Identification of Precious and Semi-precious Corals
In Commercial Trade

Ernest W.T. Cooper, Susan J. Torntore
Angela S.M. Leung, Tanya Shadbolt and Carolyn Dawe

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Glossary of Acronyms and Terms

Acronyms

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CoP	Meeting of the Conference of the Parties to CITES
EC	European Community
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GBIF	Global Biodiversity Information Facility
IUCN	International Union for Conservation of Nature
ITIS	Integrated Taxonomic Information System
NMFS	United States National Marine Fisheries Service
NOAA	United States National Oceanic and Atmospheric Administration
UNEP	United Nations Environment Programme
UNEP-WCMC	UNEP World Conservation Monitoring Centre
USFWS	United States Fish and Wildlife Service
WCMC	World Conservation Monitoring Centre (of the United Nations Environment Programme)
WED	Wildlife Enforcement Directorate (of Environment Canada)
WWF	World Wide Fund for Nature or World Wildlife Fund (in Canada and the USA)

Terms

Alcyonacea	An order in the subclass Alcyonaria (=Octocorallia) that includes soft corals (without a supporting skeletal axis) and gorgonians (with a supporting skeletal axis of gorgonin and/or calcite) (Bayer *et al.*, 1983). Alcyonacean families are distinguished primarily on the basis of overall colony growth form, presence or absence of a supporting skeletal axis, and details of axial composition (Daly *et al.*, 2007)
Alcyonaria	One of two subclasses of Anthozoa which are based mainly on polyp symmetry and tentacle form and number. Commonly referred to as Octocorallia (Fautin and Romano, 2000)

Alcyonarian	The adjectival form of Alcyonaria (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, May 3, 2011)
Anthozoa	A class of exclusively marine animals that includes sea anemones and other anemone-like groups with skeletons (e.g. corals) and without skeletons (e.g. tube anemones and sea pens) (Fautin and Romano, 2000)
Antipatharia	An order in the subclass Zoantharia (=Hexacorallia) that is composed of non-calcareous, colonial anthozoans that have a spiny, proteinaceous skeleton (Daly *et al.*, 2007). Commonly known as black coral
Arborescent	A tree-like shape with secondary branches (Bruckner, 2002)
Aragonite	A naturally occurring crystal form [polymorph] of calcium carbonate similar to calcite (Merriam-Webster, 2010)
Axial polyp	The longest polyp of a group of polyps (Bayer *et al*., 1983)
Axis	The inner supporting structure of a gorgonian (Bayer *et al*., 1983)
Benthic	Organisms occurring on the bottom of a body of water (Merriam-Webster, 2010)
Bifurcation	A division into two branches or parts (Merriam-Webster, 2010)
Bottlebrush	A colony shape consisting of a primary stem from which numerous short branches diverge from all sides of the main stem (Bruckner, 2002; S. Cairns, Smithsonian Institution, *in litt*. to E. Cooper, Feb. 16, 2011)
Calcareous	Describes an object or creature that is mainly composed of calcium carbonate (CoRIS, 2010)
Calcite	A form of calcium carbonate crystallized in hexagonal form (Merriam-Webster, 2010)
Calcium carbonate	$CaCO_3$: a calcium salt that is found in limestone, chalk, marble, plant ashes, bones, shells, coral skeletons, etc. (Merriam-Webster, 2010). Calcium carbonate is polymorphic (see definition below)

Calice	The upper or open end of a corallite in the order Scleractinia (stony coral) (CoRIS, 2010; S. Cairns, Smithsonian Institution, *in litt*. to E. Cooper, Feb. 16, 2011)
Carotenoid	Various pigments, usually yellow to red, that are found widely in plants and animals (Merriam-Webster, 2010)
Cespitose	A compact bushy shape (Bruckner, 2002)
Class	A major category in biological taxonomy ranking above order and below phylum (in animals) or division (in plants) (Merriam-Webster, 2010)
Cnida	Synonym of nematocyst
Cnidae	Plural of cnida
Cnidaria	A phylum of aquatic animals that includes the hydroids, jellyfish, sea anemones and corals (Barnes *et al.*, 2001). Also known as the Coelenterata
Coelenteron	The internal cavity within a member of the phylum Cnidaria (synonym of gastrovascular cavity) (Barnes *et al.*, 2001)
Coelenterata	Synonym of Cnidaria
Coenosteum	The area of skeleton between the corallites in the calcareous cnidarian corals [e.g. the order Scleractinia (stony coral) or family Stylasteridae (lace coral)] (Budd *et al*., 2010)
Collagen	A fibrous protein of vertebrates that is a major constituent of connective tissue (e.g. skin and tendons) and of the organic content of bones (Merriam-Webster, 2010)
Collagenous	Relating to or consisting of collagen (Merriam-Webster, 2010)
Colony	A group of interconnected, genetically identical [clone] polyps (Bayer *et al.,* 1983)
Columella	A vertical central structure within a corallite in the order Scleractinia (stony coral) (Budd *et al*., 2010)
Concentric	Having a common centre (Merriam-Webster, 2010)
Coralla	Plural of corallum (Galloway *et al*., 2007)
Corallite	The skeleton surrounding an individual polyp in a colonial calcareous coral. Solitary corals do not have corallites (S. Cairns, Smithsonian Institution, *in litt*. to E. Cooper, Feb. 16, 2011)

Corallum	The entire skeleton of a specimen in the order Scleractinia (stony coral) and Stylasteridae (lace coral) (Galloway *et al*., 2007; S. Cairns, Smithsonian Institution, *in litt*. to E. Cooper, Feb. 16, 2011)
Costae	Ridge-like extensions of the septa that extend beyond the theca (wall) of a corallite, in the order Scleractinia (stony coral) (Budd *et al*., 2010)
Dichotomous	Dividing into two equal, or almost equal parts like the arms of the letter "Y" (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Dichotomously	Branching, usually repeatedly, in a dichotomous manner (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Family	A group of related plants or animals forming a category ranking above genus and below order and usually comprising multiple genera (Merriam-Webster, 2010)
Fibrous	Containing, or consisting of, or resembling fibres (Merriam-Webster, 2010)
Foliaceous	Relating to, or resembling a plant leaf (Merriam-Webster, 2010)
Gastrovascular cavity	The internal cavity within a member of the phylum Cnidaria) (synonym of coelenteron) (Barnes *et al.*, 2001)
Genera	The plural of genus (Merriam-Webster, 2010)
Genus	A category of biological classification ranking between family and species, comprised of a single species or a number of related species (Merriam-Webster, 2010)
Glycine	$C_2H_5NO_2$: a crystalline amino acid (Merriam-Webster, 2010)
Gorgonian	A branched or unbranched alcyonarian (=octocoral) with a thin, consolidated axial skeleton formed from gorgonin (often combined with calcareous material) or from calcareous material alone (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Gorgonin	A fibrous, collagenous protein that occurs in the axial skeleton of most gorgonians (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)

Heirloom	Something of special value retained through generations (Merriam-Webster, 2010)
Helioporacea	An order in the subclass Alcyonaria (=Octocorallia) that includes two monogeneric families that are unique among octocorals in producing calcified skeletons of crystalline aragonite (Daly *et al.*, 2007)
Hexacorallia	Synonym of Zoantharia (=Hexacorallia) (Fautin and Romano, 2000)
Histidine	$C_6H_9N_3O_2$: a crystalline amino acid (Merriam-Webster, 2010)
Hydrogen peroxide	H_2O_2: a compound used especially as an oxidizing and bleaching agent, an antiseptic, and a propellant (Merriam-Webster, 2010)
Imperforate	A skeleton that is non-porous, in the order Scleractinia (stony corals) (Galloway *et al*., 2007)
In situ	In the original position or place (Merriam-Webster, 2010)
Internodes	The hard, calcareous segments of the axis of Alcyonaria (=Octocorallia) families Melithaeidae, Parisididae and Isididae (Bayer *et al.,* 1983; P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Intertidal	The part of the seashore situated between the high tide and low tide points (Merriam-Webster, 2010)
Ivory	Any mammalian tooth or tusk (or portion thereof) of commercial interest which is large enough to be carved (Espinoza and Mann, 1991)
Keratin	Any of various fibrous proteins that form the chemical basis of horny epidermal tissues such as hair and fingernails (Merriam-Webster, 2010)
Kingdom	The highest category in biological taxonomy, ranking above phylum (Merriam-Webster, 2010)
Laminated	Composed of layers of firmly united material (Merriam-Webster, 2010)
Lithify	To change to stone over time (Merriam-Webster, 2010)
Longitudinal	Placed or oriented lengthwise (Merriam-Webster, 2010)
Matrix	Material in which something is enclosed or embedded (Merriam-Webster, 2010)

Medusa	In the phylum Cnidaria: a usually free-swimming flattened disk or bell-shaped body form having the mouth positioned in the centre of the lower surface (e.g. jellyfish) (Barnes *et al.*, 2001)
Mesoglea	In the phylum Cnidaria: a gelatinous substance situated between the outer and inner layers of cells (Barnes *et al.*, 2001)
Monogeneric	A family that contains a single genus (Merriam-Webster, 2010)
Monotypic	A genus that contains a single species (Merriam-Webster, 2010)
Morphology	The form and structure of an organism or any of its parts (Merriam-Webster, 2010)
Multiplanar	Branched colonies in which the branches grow in several planes (Bayer *et al.,* 1983)
Nematocyst	In the phylum Cnidaria: minute structures that consist of a coiled hollow (and usually barbed) thread inside a fluid-filled capsule that is contained within a cell. They are usually in the tentacles and are used to attack enemies or capture prey. Also called cnida (plural: cnidae). Nematocysts are unique to and diagnostic of the phylum (Encyclopaedia Britannica, 2011; P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Node	The short flexible horny joint of the calcified axis in the Alcyonaria (=Octocorallia) families Melithaeidae, Parisididae and Isididae (Bayer *et al.,* 1983; P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011)
Octocorallia	Synonym of Alcyonaria (=Octocorallia) (Fautin and Romano, 2000)
Order	A category of taxonomic classification ranking above family and below class (Merriam-Webster, 2010)
Parties	The countries that have entered CITES into force (Cooper and Chalifour, 2004)
Perforate	A skeleton that is porous in the order Scleractinia (stony corals) (Galloway *et al*., 2007)
Phylogenetic	A number of taxa that are grouped together based on their evolutionary relationships [i.e. grouping of evolutionarily related taxa] (Merriam-Webster, 2010)

Phylum	A major group of animals sharing one or more fundamental characteristics that set them apart from all other animals and plants and forming a primary category of the animal kingdom [below kingdom and above class] (Merriam-Webster, 2010). Plural: phyla
Planar	Branched colonies in which the branches grow more or less in one plane (Bayer *et al.,* 1983)
Polymorph	Any of the crystalline forms of a polymorphic substance (Merriam-Webster, 2010)
Polymorphic	A compound that may be crystallized in two or more forms with each having a distinct structure (Merriam-Webster, 2010)
Polyp	The basic individual or structural unit of an anthozoan, which consists of a sac-like cylindrical body, a basal disk and an oral disk bearing a mouth and tentacles (Galloway *et al*., 2007)
Polyphyletic	A number of taxa that are grouped together based on some similarities but not on their evolutionary relationships—a group that includes members from different ancestral lineages (Merriam-Webster, 2010) (contrast with phylogenetic)
Precious coral	Corals that have a hard, solid skeleton that can be readily polished and are used in the manufacture of beads and other jewellery
Proteinaceous	Relating to, or containing, or resembling, or being protein (Merriam-Webster, 2010)
Radial corallites	The corallites situated along the branches of *Acropora* (staghorn coral) (Budd *et al*., 2010)
Radial symmetry	A structure having similar parts regularly arranged around a central axis (Merriam-Webster, 2010)
Range	The region throughout which a type of organism or an ecological community naturally lives (Merriam-Webster, 2010)
Recent	Of or relating to the present or a time not long past (Merriam-Webster, 2010)
Ridged	Having an elongate crest or a linear series of crests (Merriam-Webster, 2010)
Sclerite	A [microscopic] calcareous element, irrespective of form, in the tissue or axis of an octocoral (Bayer *et al.,* 1983)
Septa	Plural of septum (Galloway *et al*., 2007)

Septum	One of the skeletal plates that radiate into the calice from the theca (wall) of a corallite in the order Scleractinia (stony corals) (Galloway *et al*., 2007)
Skeleton	A usually rigid supportive or protective structure or framework of an organism (Merriam-Webster, 2010) (see also corallum)
Scleractinia	An order in the subclass Zoantharia (=Hexacorallia) that is composed of anthozoans that have a solid calcareous skeleton that is external to the soft tissues and secreted by cells at the base of polyps to form cup-like calyces subdivided by septa and into which the polyp can retract for protection (Daly *et al.*, 2007). Commonly known as stony coral
Scleractinian	The adjectival form of the noun (order) Scleractinia
Semi-precious coral	Corals that are used in the manufacture of beads and other jewellery but have a porous skeleton that does not take a high polish without the use of resin or other filler
Sp. nov.	Abbreviation of the Latin *species novum*, referring to a proposed new species (Merriam-Webster, 2010)
Species	A category in biological classification ranking immediately below the genus or subgenus (Merriam-Webster, 2010). The term species is both singular and plural
Subclass	A category in biological classification ranking between class and order (Merriam-Webster, 2010)
Suborder	A category in biological classification ranking between order and family (Merriam-Webster, 2010)
Subspecies	A category in biological classification ranking immediately below species and consisting of a population of a particular geographic region that is genetically distinguishable from other such populations of the same species (Merriam-Webster, 2010). The term subspecies is both singular and plural
Substrata	Plural of substratum (Merriam-Webster, 2010)
Substratum	A layer beneath the surface soil (Merriam-Webster, 2010)
Taxa	Plural of taxon (Merriam-Webster, 2010)
Taxon	The name applied to a taxonomic group in biological nomenclature (e.g. kingdom, phylum, class, order, family, genus, species, etc.) (Merriam-Webster, 2010)

Taxonomy	The classification of plants and animals according to their presumed natural relationships (Merriam-Webster, 2010)
Theca	The wall of a corallite in the order Scleractinia (stony coral) (Budd *et al*., 2010)
Thermoplastic	Something that is capable of softening (can be bent and moulded) when heated and of hardening again when cooled (Merriam-Webster, 2010)
Tubercles	A small knobby projection (Merriam-Webster, 2010)
Zoantharia	One of two subclasses of Anthozoa based mainly on polyp symmetry and tentacle form and number. Also known as Hexacorallia (Fautin and Romano, 2000)
Zoanthidea	An order in the subclass Zoantharia (=Hexacorallia) that is characterized by having soft-bodied polyps with two rows of marginal tentacles and an internal anatomy that is distinctive among zoantharians (Daly *et al.*, 2007)

1.0 Introduction

Historically, the term “precious coral” referred to specimens of the genus *Corallium* (red and pink coral) used in manufacturing jewellery and art objects. Today “precious coral” is often used more generally as a term for any coral species used for jewellery and other high-value objects—including coral species used to imitate the more valuable species. Grigg (1984) refers to both precious corals and semi-precious corals, which are more descriptive terms for the various types of coral used for jewellery in international trade, and are the terms the authors have chosen to use in this guide. The definition of “precious” vs. “semi-precious” is somewhat arbitrary, but for the purposes of this publication the precious corals are those that have a hard, solid skeleton that can be readily polished; and the semi-precious corals are those that have a porous skeleton that does not take a high polish without the use of resin or other filler.

The skeleton of almost any hard coral could hypothetically be made into beads, jewellery and similar products. But production of a guide to the identification of every coral with a skeleton hard enough to use as jewellery would hardly be feasible, or needed. This guide is therefore focused specifically on those taxa that are commonly found in commercial trade, and therefore comprise the great majority of precious and semi-precious coral products available. As a result, there are some coral taxa that may be infrequently encountered that have not been described in this publication. For example, Polish Customs Officers have come across (fairly crude) fragments of *Tubipora musica* (organ pipe coral) being used in jewellery (V. Fleming, UK Joint Nature Conservation Committee, *in litt*. to E. Cooper, February 28, 2011); and in the 1970s products made from Plexauridae (angel corals) were available for sale in Mexico and the Dominican Republic (K. Muzik, Scientific Consultant, *in litt*. to E. Cooper, Feb. 25, 2011). Neither of these two taxa is included in this guide. Perhaps the biggest gap in this publication is the lack of content on the identification of the Stylasteridae (lace corals). Products made from Stylasteridae have been noted to be in trade, some species are naturally coloured, and

1.0 Introduction (continued)

specimens could be dyed and used as substitutes for *Corallium* (Karampelas *et al.,* 2009). However, the authors were unable to find evidence of current commercial harvest and trade in the taxon, and worked specimens were not readily available, so a description of the taxa was not included.

Products made from precious and semi-precious corals command high prices and near-global market demand. As a result, their trade is extensive, profitable and provides ample incentive for their harvest. Unfortunately, most of these coral species have life-history characteristics that make them particularly vulnerable to over-exploitation: extreme longevity, late age of maturity, slow growth and low fecundity. In some cases, for at least one taxon (Coralliidae) discovery of commercially viable beds has led to rapid exploitation and subsequent exhaustion of the resource (Anon., 2007). In addition, the use of destructive bottom trawls and dredges to harvest corals in some regions not only removes the corals—which provide critical habitat for sessile invertebrates—but also damages bottom features and destroys the bottom-dwelling organisms in their paths (Anon., 2007).

The international scope of the trade in precious and semi-precious corals necessitates that countries manage and enforce trade regulations and international agreements concerning these species, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although many coral species are protected by CITES, the ability of the Parties (member countries of the Convention) to regulate their trade is impacted by the lack of resources designed to assist both with identifying CITES-listed precious and semi-precious corals, and distinguishing them from those taxa that are not listed. This publication is the first comprehensive guide to the identification of these corals.

The target audience for this guide is enforcement officers (e.g. Wildlife Inspectors, Customs Inspectors, etc.) that are responsible for implementing regulations on the international trade in precious

1.0 Introduction (continued)

corals—primarily, but not exclusively CITES. In addition, the guide will be valuable to fisheries managers and scientists who are involved with conservation of coral resources. This includes scientific, management and enforcement authorities in the 175 Parties to CITES.

The typical enforcement officer is not likely to be an expert on coral morphology and taxonomy. The challenge in producing this guide is to take detailed morphological and taxonomic information and present it in a format that is readily understandable by a layperson.

There are two basic needs that must be met for a non-expert to become adept at identifying wildlife products:

- Access to clear, practical information on identifying characteristics and identification techniques.

- Access to a large variety of items made from the taxa in question which provides the information required to distinguish the morphological variation within a taxon from those that define different taxa.

This publication has been designed to provide these needs by adhering to the following guidelines:

- Provision of straightforward, clear text with minimal technical jargon. All technical terms are clearly explained and a glossary has been included in the publication.

- Extensive use of high quality photographs and graphics. The information provided in the text of the guide is plainly illustrated to ensure that it is understandable and unambiguous. A large number of photographs of a wide variety of possible parts, products and derivatives has been included to illustrate the morphological variation within and between each taxon, and to reinforce their identification.

1.0 Introduction (continued)

This guide is divided into three parts. This introduction concludes Part 1. Part 2 describes the methods used to complete this guide, and Part 3 constitutes the substance of the guide by providing detailed descriptions of the taxa commercially traded as precious or semi-precious coral and how to identify them. Part 3 is divided into a series of sections and subsections, each of which describes a specific taxon.

2.0 Methods

General

The information compiled in this guide was obtained through the following methods:

- **Examination of coral specimens**: a collection of approximately 160 specimens of precious and semi-precious corals was amassed specifically for developing this publication. These specimens were purchased from retail outlets and/or donated or loaned from the sources noted in the Acknowledgements of this guide. Additional specimens were accessed in the collections of Dorian Rae, Smithsonian Institution, Vancouver Aquarium, Simon Fraser University, the private collection of Susan J. Torntore and the private *Corallium* coral museum of Antonino De Simone in Naples, Italy.

- **Literature reviews**: online and in-print literature was reviewed for information pertinent to this publication. Preference was given to refereed journals and non-refereed publications from well-known, credible sources. Whenever possible, information was tracked back to the original source and all information obtained from the literature was confirmed via review of multiple sources and/or examination of known specimens.

- **Verbal and written communication**: with scientists and other coral experts via phone, email and in-person. The final text was reviewed by an international team of experts as noted in the Acknowledgements.

Photography
Unless otherwise noted, all of the photographs used in this publication were taken by Ernest W.T. Cooper using either an Olympus E-500 or E-620 single lens reflex digital camera and Zuiko Digital 35 mm F3.5 macro lens. Approximately 4,000 photographs were taken specifically for possible use in this guide.

In order to ensure consistent colour, lighting and composition, the majority of the specimens illustrated in this guide were photographed with the camera secured on a Kaiser RS1 copy stand and the specimen placed on a fluorescent light box. The light box was the sole source of lighting and foam board[1] reflectors were positioned to reflect diffuse white light back onto the specimen. The white balance of the camera was adjusted to match the light produced by the light box and the exposure was corrected as needed to accurately photograph the specimen. The result of this technique was photographs of specimens with a shadowless white background. Photographs were saved as JPEGs and edited with Adobe Photoshop CS3. Editing consisted of correcting (if necessary) the colour, adjusting the brightness and contrast to ensure the clearest possible images and cropping as required.

Specimens that could not be relocated to the studio (e.g. those for sale in a retail outlet or located in a museum collection) were photographed *in situ* using either an Olympus SRF-11 electronic ring flash or the on-camera electronic flash.

Hot-point test
Hot-point tests were conducted on specimens of each taxon of coral, plus some similar products as described in this publication. Each test was

[1]Commercially available lightweight board of polystyrene laminated with white paper.

2.0 Methods (continued)

completed by heating the point of a needle red-hot in the flame of a hand-held butane torch, then touching it to the item and noting whether the specimen burned (or melted) and the smell produced (if any).

Hydrogen peroxide test

Specimens suspected to be black coral (Antipatharia spp.) and specimens of possible imitations were tested through contact with hydrogen peroxide. Each specimen was submerged in a 50 percent hydrogen peroxide solution for 80 minutes. The specimen was then examined to determine whether it had reacted to the solution. If the surface of the specimen turned shiny gold, it was considered a positive test, and indicated the specimen was black coral. If the specimen bleached or in any other way reacted to the hydrogen peroxide but did not turn gold, the test was considered negative and indicated the specimen was not black coral. [Note: immersion in a 3 percent solution, as sold for use in first aid, does not yield suitable results.]

Solvents

Different solvents were applied to coral specimens using cotton swabs to test whether the colours exhibited were natural or the result of dyes. The solvents were chosen to be those that should be readily available to enforcement officers: distilled water, acetone and acetone-free nail polish remover. Of these, acetone-free nail polish remover was found to be the most consistently effective.

3.0 Taxonomic Descriptions

Although the term “coral” is widely and commonly used, according to Cairns (2007) its exact definition is difficult to establish as it is not a scientific term, but rather a layman’s term that embraces a polyphyletic assemblage (an artificial grouping of taxa) of several animal groups. Cairns (2007) suggested the following definition for the term:

“Coral: Animals in the cnidarian classes Anthozoa and Hydrozoa that produce either calcium carbonate (aragonitic or calcitic) secretions resulting in a continuous skeleton or as numerous, usually microscopic, individual sclerites, or that have a black, horn-like, proteinaceous axis.”

Together, the precious and semi-precious corals meet the definition suggested by Cairns (2007) and form a separate polyphyletic group of animals that produce skeletons that have commercial value for the production of jewellery and similar items. Scientifically, there is no value in grouping the precious and semi-precious corals together.

The phylum Cnidaria includes the hydroids, jellyfish, sea anemones and corals—all of which are aquatic and most are marine. According to Barnes *et al.* (2001), the distinguishing characteristics of the phylum include the following:

- A radially symmetrical body that forms a tube around a central cavity (called the coelenteron or gastrovascular cavity) that is open at one end (the mouth) with a series of tentacles surrounding the opening.

- Two layers of cells separated by a layer of gelatinous mesoglea which may or may not contain cells.

- The presence of nematocysts (or nematocyst-like organelles).

3.0 Taxonomic Descriptions (continued)

Cnidarians have bodies that may be in one of two forms (possibly alternating during the life cycle of a species) (Barnes *et al.*, 2001):

- Polyp: an elongated form attached to a substrate with the mouth and tentacles uppermost.

- Medusa: a flattened disk or bell-shaped form with the mouth positioned in the centre of the lower surface. Medusae are usually free-swimming.

All members of the class Anthozoa are marine and benthic (bottom-dwelling). They exclusively incorporate the polyp body form and may be colonial (many polyps united as a single animal) or solitary. They may form a mineral and/or a proteinaceous skeleton, or they may have no skeleton at all (Daly *et al.*, 2007). The class Anthozoa includes the sea anemones and corals. The class Anthozoa is divided into two subclasses: the Alcyonaria (=Octocorallia) and the Zoantharia (=Hexacorallia) (Fautin and Romano, 2000)[2]. All of the precious and semi-precious corals are members of these two subclasses, but are separated into a variety of different orders, suborders, families, genera and species as summarized in **FIGURE 3.1.**

[2] Some sources, e.g. ITIS (2010) also recognize a third subclass: the Ceriantipatharia

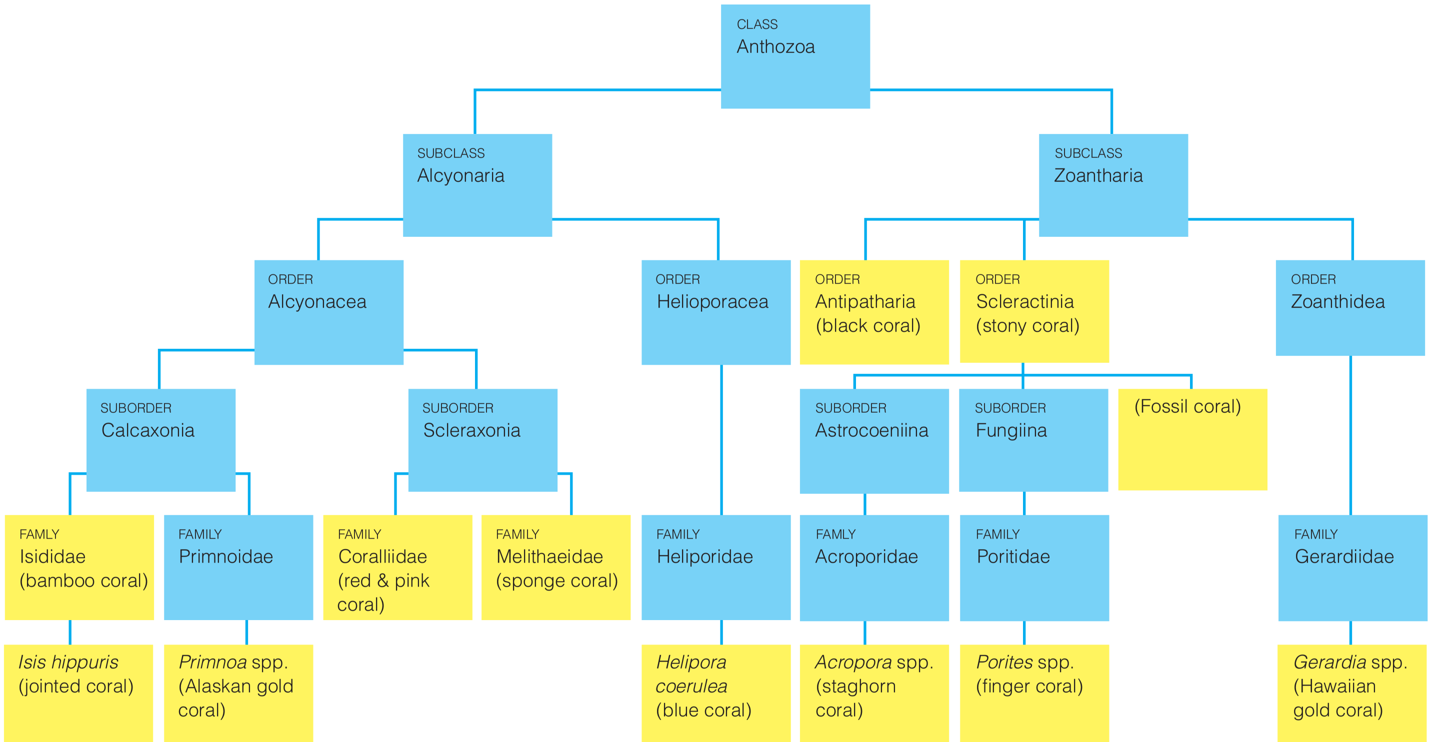
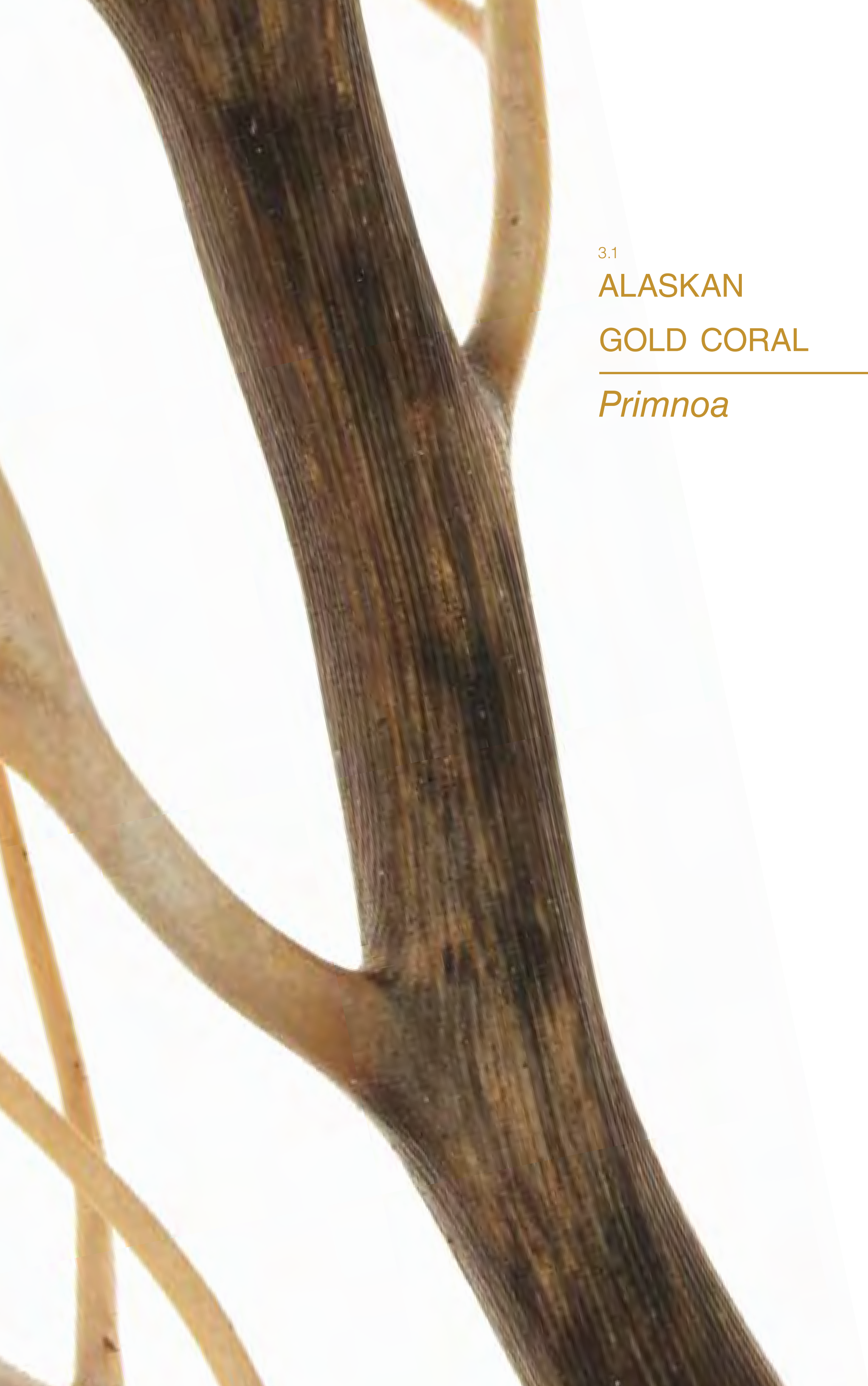


FIGURE 3.1 Summary of the taxonomy of precious and semi-precious corals. The taxa described in this guide are shown in the yellow boxes.



3.1

ALASKAN GOLD CORAL

Primnoa

3.1 Alaskan Gold Coral *Primnoa* Lamouroux, 1812

FIGURE 3.1.1 a whole dried colony of *Primnoa pacifica* that is still covered with dried tissue.

Other Common Names

ENGLISH	Alaskan gold coral; bush coral; gold coral; popcorn coral; red trees; sea corn; spruce trees
FRENCH	Corail popcorn
SPANISH	Corales dorados

Taxonomy

According to Cairns and Bayer (2005) there are four species in the genus *Primnoa.* The classification of the genus, sourced from Cairns and Bayer (2005), ITIS (2010) and van Ofwegen (2010a) is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Alcyonaria (=Octocorallia)
ORDER Alcyonacea Lamouroux, 1816
SUBORDER Calcaxonia Grasshoff, 1999
FAMILY Primnoidae Gray, 1858
GENUS *Primnoa* Lamouroux, 1812

Box 3.1 Note Regarding *Primnoa*

Currently, large-scale commercial harvest and trade of specimens of *Primnoa* does not appear to be occurring. However, some coral specimens that are acquired through fishing activities are likely retained and heirloom jewellery pieces made from *Primnoa* can be expected to be occasionally encountered in trade.

Distribution

- Species of *Primnoa* range through the north Atlantic and Pacific Oceans, including the coastal waters of Norway, Greenland, Nova Scotia, British Columbia and Alaska (Krieger and Wing, 2002); and in the Indian Ocean and off New Zealand (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, July 6, 2011). In the United States the Primnoidae appear to reach their highest abundance in Alaska (Etnoyer and Morgan, 2003).

- The minimum depth for species of *Primnoa* is nine metres while the maximum recorded depth is 1,029 metres (Cairns and Bayer, 2005). Etnoyer and Morgan (2003) noted that the northeast Pacific depth range for the Primnoidae was 25–2,600 metres, with the majority in waters shallower than 400 metres. Cairns and Bayer (2005) reported that *P. resedaeformis* was among the most abundant species in the northwestern Atlantic where it occurs in depths of 91–548 metres.

- Colonies of *Primnoa* are often observed attached to boulders or bedrocks. At least one species (*P. pacifica*) forms dense thickets in the Gulf of Alaska (Krieger and Wing, 2002).

Multinational Conservation Status

- As of 2010, no species of *Primnoa* had been assessed in the IUCN Red List of Threatened Species or listed in the Appendices of CITES, and there was no international regulation of trade in specimens of *Primnoa*.

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Alcyonacea (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of *Primnoa* in waters outside of their respective exclusive economic zones.

Characteristics

- Colonies of *Primnoa* are dichotomously branched and tree-like in shape **(FIGURE 3.1.1)**. They can exceed a height of two metres and a width of seven metres (Cairns and Bayer, 2005; Krieger and Wing, 2002).

- Skeletons of *Primnoa* are composed of proteinaceous gorgonin impregnated with calcite (a form of calcium carbonate) (Lumsden *et al.,* 2007). The mixture of calcium carbonate and protein is characteristic of the skeletons of the suborder Calcaxonia. The percentage of the skeleton that is composed of calcium carbonate is relatively minor (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, Nov. 3, 2010). Since the coral's skeleton has little calcium carbonate, it is not noticeably cool to the touch.

- The surface of a skeleton of *Primnoa* exhibits parallel longitudinal ridges approximately 0.5 millimetres apart **(FIGURE 3.1.2)**. Once the coral is polished, the ridges appear as parallel lines in the material **(FIGURES 3.1.3–3.1.5)**.

- The main stem of a skeleton of *Primnoa* may be up to six centimetres in diameter (Cairns and Bayer, 2005). In cross-section the main stem resembles a section of a tree trunk with the concentric layers appearing comparable to the annual rings of wood **(FIGURE 3.1.4)**.

- When cut and polished, the skeletal material is golden brown to brown in colour **(FIGURES 3.1.3–3.1.5)**. Cairns and Bayer (2005) suggested that polished specimens of *Primnoa* resemble agate or petrified wood.

- A hot-point test (e.g. touched with a red-hot needle) of a sample of *Primnoa* will produce the smell of burning hair.

(A)

(B)

(C)

FIGURE 3.1.2 Close-up views of dried skeletons of *Primnoa* showing the characteristic longitudinal surface ridges: **(A)** *P. pacifica;* **(B)** *Primnoa sp.;* and **(C)** *P. resedaeformis.*

Note that specimen **(A)** had been freshly cleaned of tissue before being photographed and shows the characteristic golden brown colour.

FIGURE 3.1.3 1 cm

FIGURE 3.1.4 1 cm

FIGURE 3.1.5 1 cm

FIGURE 3.1.3 A polished piece of Alaskan gold coral skeleton showing the characteristic golden brown colour and longitudinal lines that are remnants of the surface ridges.

FIGURE 3.1.4 A pendant made from a cross-section of an Alaskan gold coral skeleton.

FIGURE 3.1.5 Earrings made from pieces of Alaskan gold coral skeleton.

Trade

- Lumsden *et al*. (2007) reported that in Alaska, a fishery for corals was proposed but never developed. However, according to Cairns *et al*. (2005), specimens of *Primnoa* were historically harvested by Alaskan fisherman largely as a by-catch of halibut fisheries and sold for $20–$25/lb. Apparently there was a substantial market until about 1980.

- Krieger and Wing (2002) reported that during 1997–2002, less than 200 kilograms of *Primnoa* were harvested per year for the jewellery trade.

- Cimberg *et al*. (1981) reported two species of *Primnoa* in trade: *P. resedaeformis* and *P. willeyi.*

Similar Products

- Hard, dense woods could be mistaken for products made from *Primnoa* if the colour of the wood was a similar golden-brown. The growth rings of wood may be similar to those of the skeleton of *Primnoa*. However, a hot-point test on a specimen of wood will produce the smell of burning wood whereas a hot-point test of a sample of *Primnoa* will produce the smell of burning hair.

- Dry, unpolished skeletons of Antipatharia (black coral) may appear superficially similar to those of unpolished *Primnoa* as specimens of Antipatharia exhibit similar growth rings and have a similar texture and consistency. However, the surface of a skeleton of Antipatharia is characterized by the presence of small spines (FIGURE 3.1.6, and SEE SECTION 3.3 BLACK CORAL), which are not present on specimens of *Primnoa*; and Antipatharia do not exhibit the longitudinal surface ridges and lines seen in *Primnoa*. When polished, the skeletons of Antipatharia no longer have spines and products typically appear black in colour under direct light rather than the golden-brown of items made from *Primnoa* (SEE SECTION 3.3 BLACK CORAL).

- Specimens of *Gerardia* (Hawaiian gold coral) exhibit growth rings like those of *Primnoa*, and have a similar texture and consistency. However, those of *Gerardia* are more truly golden in colour and have a smooth surface texture that is finely dimpled, rather than the striated surface of the skeleton of *Primnoa* (**FIGURE 3.1.6**, and see section 3.5 Hawaiian gold coral).

(A)

(B)

(C)

FIGURE 3.1.6 A comparison of close-up views of the skeletons of **(A)** Alaskan gold coral; **(B)** black coral (Antipatharia); and **(C)** Hawaiian gold coral (*Gerardia*).

3.2

BAMBOO CORAL

Isididae

3.2.1

JOINTED CORAL

Isis hippuris

3.2 Bamboo Coral
Isididae Lamouroux, 1812

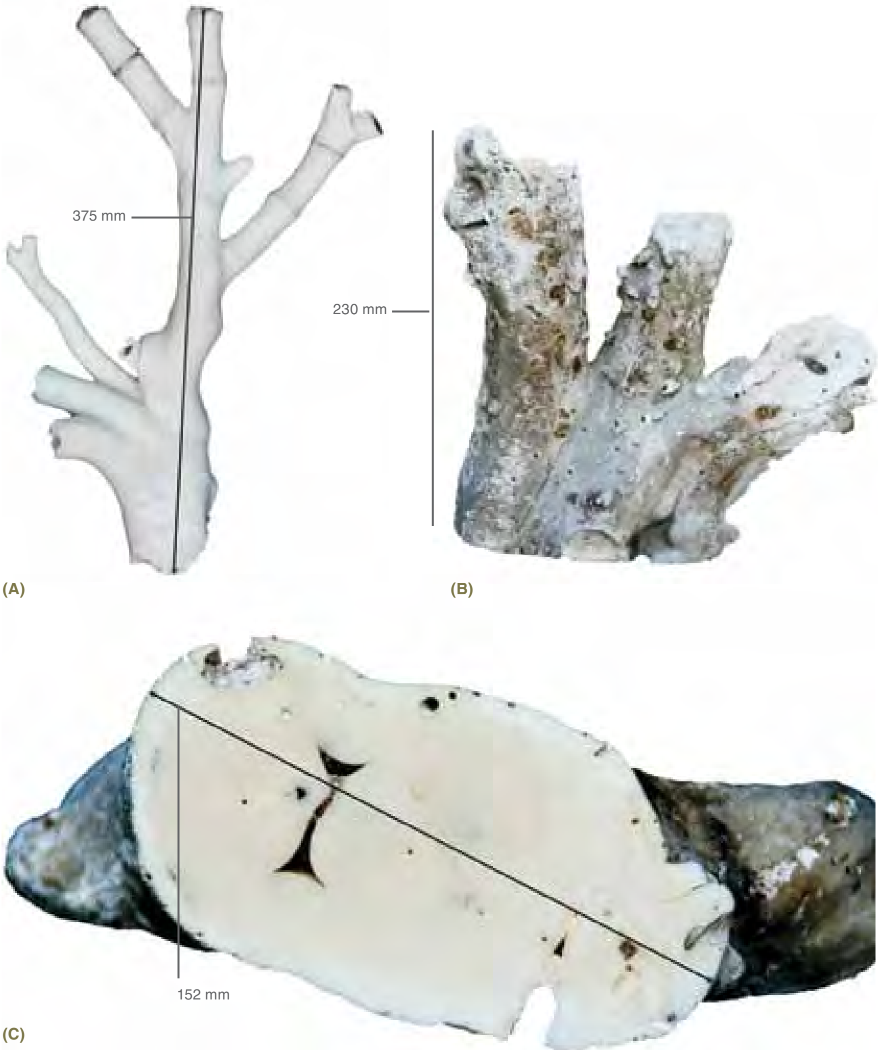


FIGURE 3.2.1 (A–C) basal pieces of skeleton from very large specimens of bamboo coral; **(C)** a cross-section of **(B)**. Photographs © Phil Alderslade.

Other Common Names

ENGLISH	Chinese coral; colour-enhanced red coral; dyed red coral; grass coral; king coral; sea bamboo coral; tiger coral
FRENCH	Corail bamboo; corail bambou
JAPANESE	Tokusa sango; kai chiku
SPANISH	Coral bambú

Taxonomy

There are 38 genera described in the family Isididae (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 22, 2011). The classification of the Isididae, sourced from ITIS (2010) and van Ofwegen (2010b), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Alcyonaria (=Octocorallia)
ORDER Alcyonacea Lamouroux, 1816
SUBORDER Calcaxonia Grasshoff, 1999
FAMILY Isididae Lamouroux, 1812

Distribution

- Corals of the family Isididae are widely distributed in most major bodies of water in the world (Anon., 2011). In the Pacific Ocean, specimens of Isididae have been gathered from Alaska to New Zealand (Heifetz, 2002; Smith *et al.,* 2004; Reed and Ross, 2005).

Box 3.2 Note Regarding Isididae

As of the writing of this guide, bamboo coral was very common in trade and readily available in retail outlets around the world. Most commonly these products were dyed red to imitate Coralliidae (red and pink coral), but bamboo coral may be dyed a wide variety of colours.

Multinational Conservation Status

- As of 2010, no species of Isididae had been assessed in the IUCN Red List of Threatened Species or listed in the Appendices of CITES, and there was no international regulation of trade in Isididae.

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Alcyonacea (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of Isididae in waters outside of their respective exclusive economic zones.

Characteristics

- Colonies of Isididae can occur in many growth forms. The deepwater species may be unbranched or branched in a sparse to very dense dichotomous or candelabra-like manner and may be very large—with a thick base and reaching heights of greater than 10 metres (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011) **(FIGURE 3.2.1).**

- Colonies of Isididae are characterized by a skeleton consisting of calcareous internodes (composed of calcium carbonate) interspersed with nodes of proteinaceous gorgonin **(FIGURE 3.2.2–3.2.3)**. This gives the axis of these corals the superficial appearance of canes of bamboo (Pedersen, 2004; Daly *et al.,* 2007). In the older, more basal parts of the skeletons of Isididae the nodal material is often overgrown with internodal calcium carbonate (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, June 19, 2011) **(FIGURE 3.2.4).**

- The surface of the calcareous internodes of large species [including those typically in commercial trade] may exhibit parallel longitudinal ridges (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011) **(FIGURE 3.2.5)**. These ridges range from approximately 0.4 to 1 mm apart (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 30, 2011). Once the coral is polished, traces of the ridges may be observed as faint longitudinal lines in the material **(FIGURE 3.2.5)**. Under low magnification, a cross-section of a skeleton of Isididae will often show these continued as weak radial lines **(FIGURE 3.2.6)**. These lines are particularly visible in dyed specimens **(FIGURE 3.2.7)**. Faint concentric lines may also be visible in the cross-section of an axis (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 22, 2011).

- If subjected to a hot-point test, the gorgonin nodes will burn and produce a smell similar to that of burning hair. The calcareous internodes will not react significantly to a hot-point test.

Characteristics (continued)

- The natural colour of the calcareous internodes of large species is off-white or pale brown while their gorgonian nodes are dark brown or black **(FIGURES 3.2.2; 3.2.5–3.2.6).** but can be paler and often translucent (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011). Products made from the internodes are often dyed a wide range of colours, although they are most commonly dyed deep red, possibly to imitate specimens of Coralliidae **(FIGURES 3.2.9–3.2.10)**. Items made from the calcareous internodes of Isididae typically also include fragments of gorgonin **(FIGURES 3.2.9–3.2.12)** which remain darkly coloured and do not take up the dye used to colour the internodes. Very small beads made from Isididae may not exhibit any gorgonin.

- In dyed specimens, traces of dye or more deeply coloured areas may be visible in small cavities (e.g. the stringing hole in a bead) and defects in a specimen **(FIGURE 3.2.13)**. Chipping or splitting a bead to allow examination of its interior will also frequently show the lack of dye penetration (Torntore, 2009) **(FIGURE 3.2.14)**. Alternatively, dyed specimens can be recognized by swabbing the surface with a solvent such as acetone-free nail polish remover (SEE SECTION 2.0 METHODS) **(FIGURE 3.2.15)**.

- Products made from Isididae are cool to the touch.

FIGURE 3.2.2
(A)

(B)

(C)

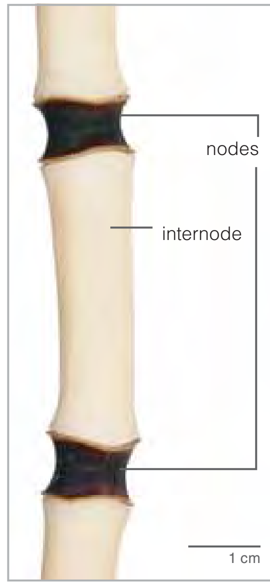


FIGURE 3.2.3

FIGURE 3.2.2 Close-up views of pieces of dried bamboo coral: **(A)** *Lepidisis olapa*; **(B)** *Keratoisis paucispinosa*; and **(C)** *Isis hippuris*.

FIGURE 3.2.3 A close-up view of a clean, dried piece of bamboo coral (*Keratoisis paucispinosa*) skeleton showing the characteristic morphology consisting of calcareous internodes and gorgonin nodes.

FIGURE 3.2.4
(A)

(B)

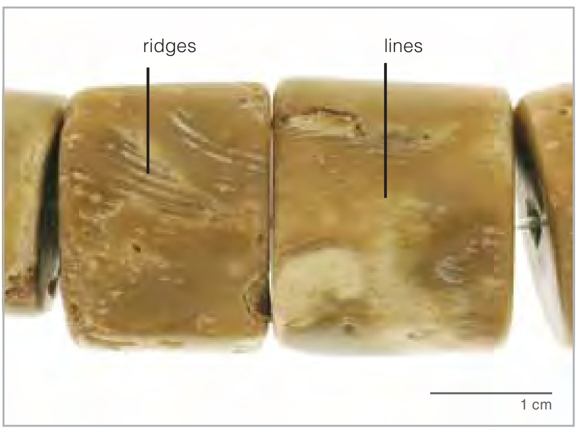


FIGURE 3.2.5

FIGURE 3.2.6

FIGURE 3.2.4 (A–B) Two sides of three polished and dyed pieces of bamboo coral skeleton (*Isis hippuris*). Note that in these pieces the nodes have been overgrown with internodal calcium carbonate.

FIGURE 3.2.5 Close-up side view of beads made from pieces of bamboo coral that have been roughly polished. The characteristic longitudinal surface ridges can be seen in the unpolished areas and corresponding longitudinal lines in the material can be seen in the polished areas.

FIGURE 3.2.6 A close-up end view of beads made from pieces of bamboo coral that have been roughly polished. Traces of the characteristic longitudinal surface ridges can be seen as weak radial lines in the material.

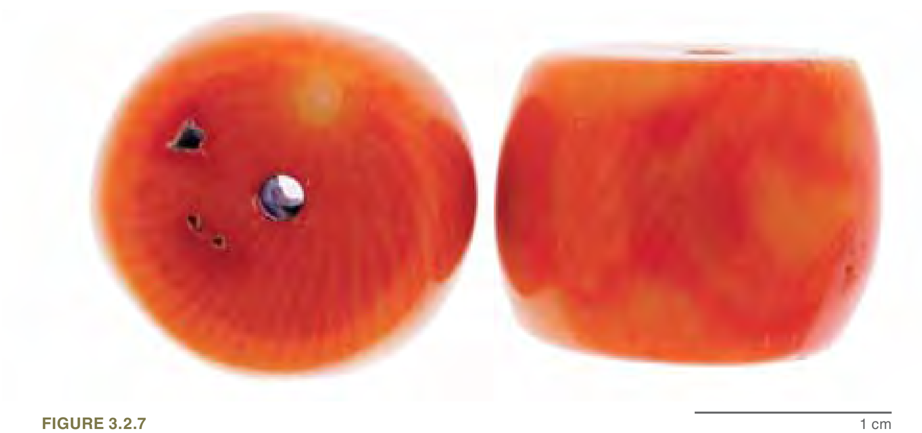


FIGURE 3.2.7

FIGURE 3.2.8

FIGURE 3.2.7 A close-up view of dyed beads made from polished pieces of bamboo coral skeleton. The characteristic longitudinal and radial lines in the material can be seen in both the side and end views.

FIGURE 3.2.8 Naturally coloured beads made from polished pieces of bamboo coral skeleton.

FIGURE 3.2.9 Beads made from pieces of bamboo coral skeleton that have been dyed red: **(A)** disk-shaped; **(B)** rice-shaped; **(C)** hourglass-shaped; and **(D)** spheres. Note the fragments of black gorgonin retained within the disk-shaped beads.

FIGURE 3.2.10 Beads made from small, irregular pieces of bamboo coral skeleton that have been dyed red.

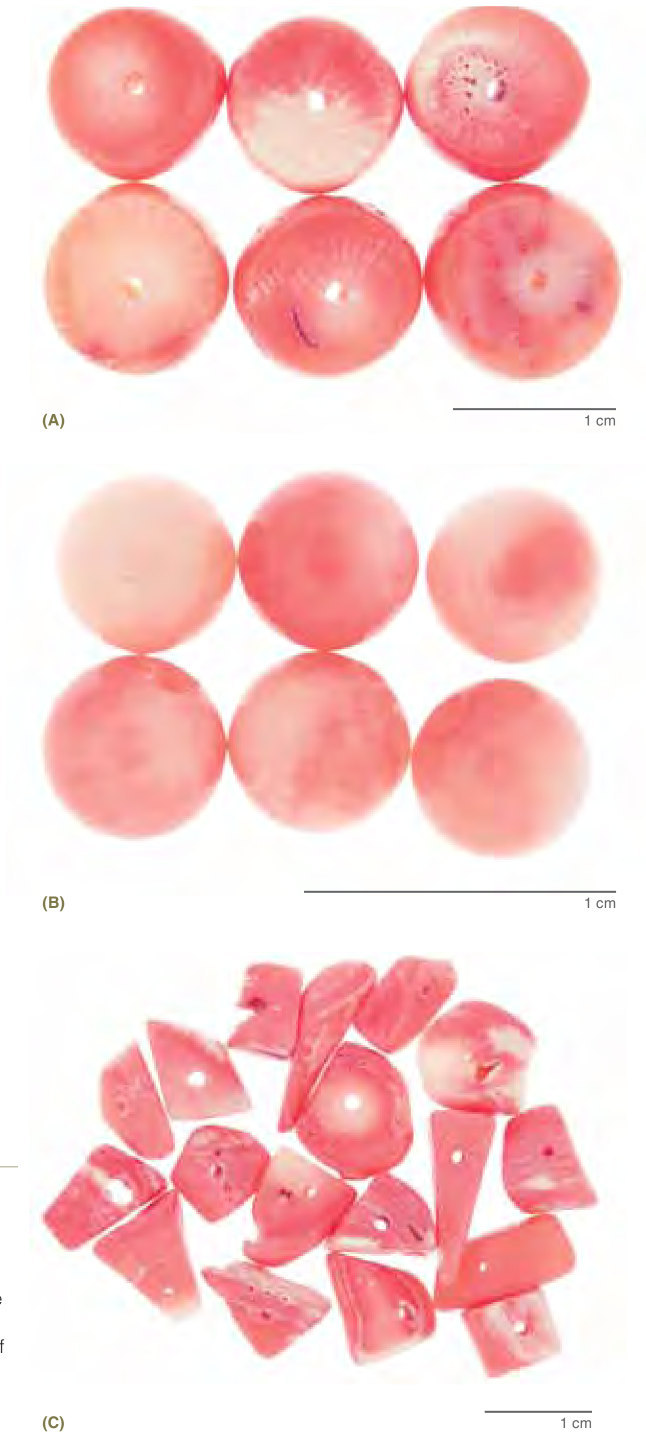


FIGURE 3.2.11 Beads made from pieces of bamboo coral skeleton that have been dyed pink: **(A)** disk-shaped; **(B)** spheres; and **(C)** irregular. Note the inconsistent application of the colour and the fragments of black gorgonin retained within the disk-shaped and irregular beads.

FIGURE 3.2.12

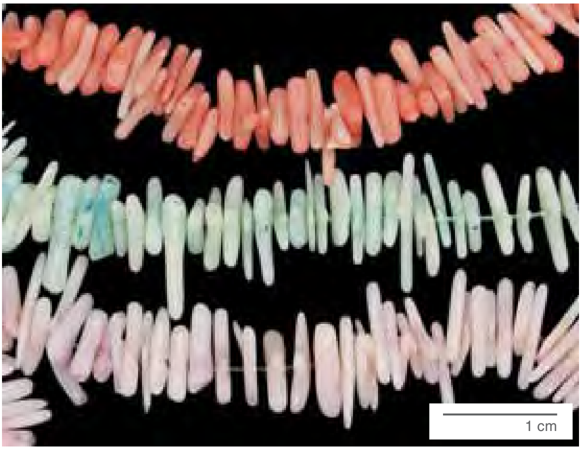


FIGURE 3.2.13

FIGURE 3.2.12 Rice-shaped beads made from pieces of bamboo coral skeleton that have been dyed orange. Note the inconsistent application of the colour and the fragments of black gorgonin.

FIGURE 3.2.13 Beads made from small, irregular pieces of bamboo coral skeleton that have been dyed different colours. Note the inconsistent application of the dye.

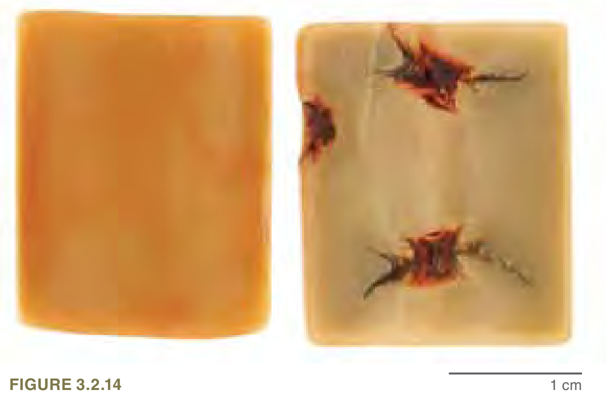


FIGURE 3.2.14
(A) **(B)**

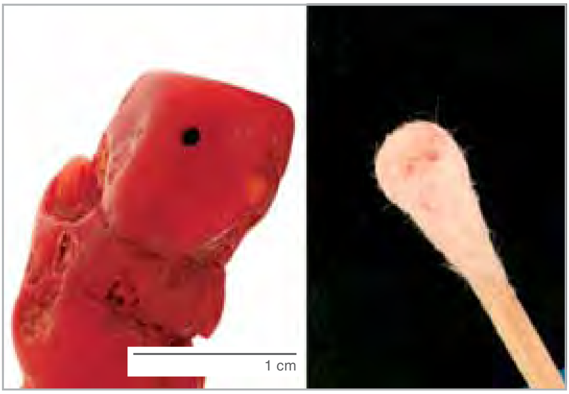


FIGURE 3.2.15
(A) **(B)**

FIGURE 3.2.14 A cylinder shaped bead made from bamboo coral skeleton that has been dyed orange. The bead has been split in half to show that **(A)** the dye coloured the outer surface; and **(B)** did not penetrate to the interior.

FIGURE 3.2.15 **(A)** a piece of bamboo coral skeleton that has been dyed red; and **(B)** a cotton swab soaked in acetone-free nail polish remover that has been used to remove some of the dye.

Trade

- The skeletons of Isididae are commonly used for the creation of jewellery. Skeleton fragments are found in trade in various forms (e.g. sections of branches, beads, etc.) and may be unpolished or polished. Manufactured products include pendants, rings, bracelets and necklaces, etc. (**FIGURES 3.2.16–3.2.17**).

- Larger colonies could be found in the marine curio trade.

- Grigg (1984) and Tsounis *et al.* (2010) note three different genera of Isididae as being used for jewellery: *Acanella, Keratoisis* and *Lepidisis.* However, during the course of researching and preparing this guide, all of the products made from Isididae and examined by the authors that could be identified were determined to be from the species *Isis hippuris* (jointed coral). *I. hippuris* is widely distributed in the Pacific Ocean in shallow waters, and is therefore much more readily accessible than deepwater species which would require specialised fishing gear to collect (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, April 9, 2011). Therefore, products made from *I. hippuris* appear to constitute a significant portion of the products made from Isididae in international trade (SEE SUBSECTION 3.2.1 JOINTED CORAL).

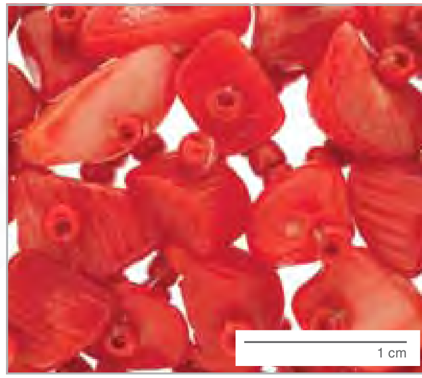


FIGURE 3.2.16
(A) **(B)**

FIGURE 3.2.17
(A) **(B)**

FIGURE 3.2.16 (A) a bracelet (from India) made from small, irregular pieces of dyed bamboo coral (Isididae) skeleton and spherical glass beads; and **(B)** a close-up view.

FIGURE 3.2.17 (A) a Native American necklace made with small, irregular pieces of bamboo coral skeleton that have been dyed red; and **(B)** a close-up view.

Similar Products

- Plastic beads may exhibit the same colours and glossiness as products made from Isididae. However, plastic is not cool to the touch, lacks the characteristic longitudinal ridges or lines and gorgonin nodes of skeletons of Isididae (Pedersen, 2004), and can be readily scratched or damaged **(FIGURE 3.2.18)**. See also section 3.6 Red and Pink Coral.

- Glass beads may be similar in appearance to products made from Isididae as they are smooth, hard and cool to the touch, but can be distinguished by the lack of longitudinal ridges or lines and gorgonin nodes. In addition, glass beads may contain air bubbles and other flaws (Pedersen, 2004) **(FIGURES 3.2.19–3.2.20)**. See also section 3.6 Red and Pink Coral.

- The skeletons of Coralliidae have longitudinal ridges similar to those of Isididae. However, the ridges (and lines in polished specimens) of Coralliidae are much finer (approximately 0.25 to 0.5 mm apart) than those of the Isididae commonly found in trade (Pedersen, 2004; O'Donoghue, 2006; Smith *et al.,* 2007) **(FIGURE 3.2.21)**. The skeletons of Coralliidae are most commonly (but not always) a natural shade of red in colour, whereas the internodes of Isididae are naturally off-white and may be dyed different colours (often to imitate Coralliidae). Unlike the skeletons of Isididae, Coralliidae do not have gorgonin nodes (SEE SECTION 3.6 RED AND PINK CORAL).

- Polished and undyed products made from the skeletons of Isididae could appear similar to ivory[3] **(FIGURE 3.2.22)**. However, ivory is not cool to the touch and is softer and therefore more easily scratched or cut. Also, each type of ivory in trade exhibits distinctive macroscopic and/or microscopic characteristics that are not present in coral skeletons. See Espinoza and Mann (1991) for more information on the identification of ivory.

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[3]Living species that are common sources of ivory include the African and Asian elephants (*Loxodonta africana* and *Elephas maximus*); hippopotamus (*Hippopotamus amphibius*); narwhal (*Monodon monoceros*); sperm whale (*Physeter macrocephalus*); walrus (*Odobenus rosmarus*); and warthog (*Phacochoerus africanus*). Ivory from the extinct wooly mammoth (*Mammuthus primigenus*) is also common in international trade.

Similar Products (continued)

- Species of the genus *Parisis* (Family Parisididae) also fit the description of bamboo corals. The difference is that the axis is formed from sclerites fused or cemented together, so the surface is not smooth, and there are also sclerites in the gorgonin of the nodes. Colonies do not grow as big as large species of Isididae, the largest being about 50 cm, but the internodes of the main stems, which have pronounced longitudinal ridges, could be utilized for small items. Shallow-water species of *Parisis* are not common and have not been reported from the coral reefs where Isididae is typically processed (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011). *Parisis* has not been reported as being in trade.

- Shell products may be mistaken for products made from Isididae as they have similar density and composition, and have layers that may appear similar to the longitudinal lines seen in specimens of polished Isididae. However, shell layers are composed of alternating light and dark material that are much thicker than the lines of Isididae. Furthermore, the layers in shell material are parallel to one another and form lines that do not converge to a central point in cross-section the way that the lines of Isididae do **(FIGURE 3.2.23)**.

FIGURE 3.2.18
(A) **(B)** **(C)**

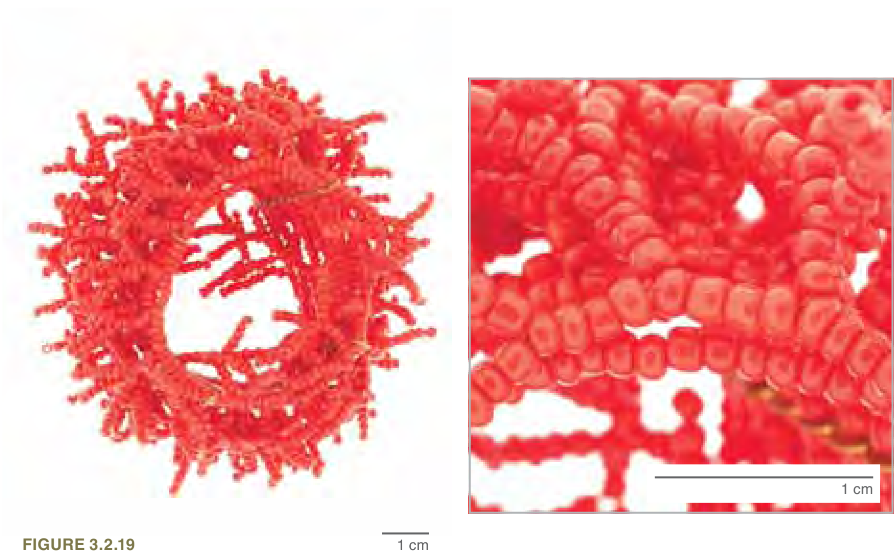


FIGURE 3.2.19
(A) **(B)**

FIGURE 3.2.18 Items made from red plastic which could be possible imitations of bamboo coral: **(A-B)** pendants; **(C)** push-pin.

FIGURE 3.2.19 **(A)** a bracelet (from India) made from small, spherical red glass beads; and **(B)** a close-up view.

FIGURE 3.2.20

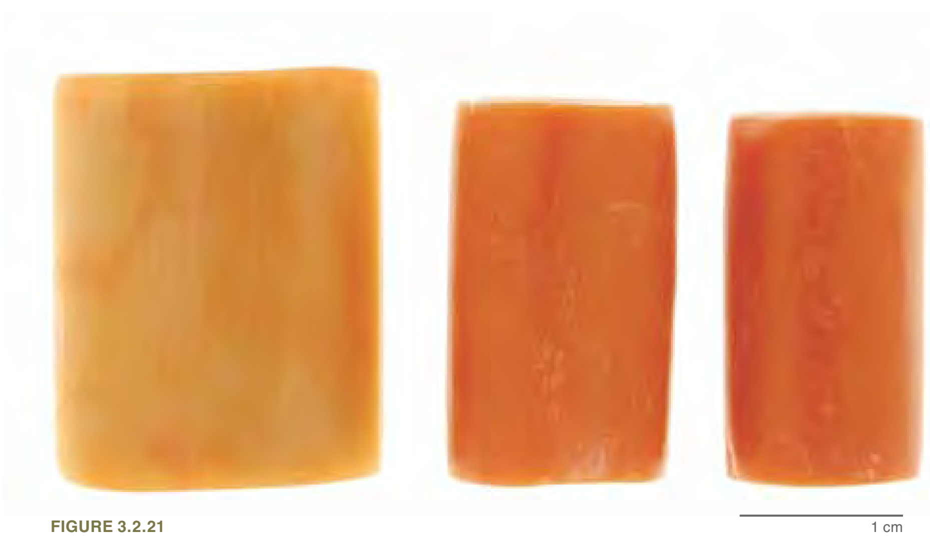


FIGURE 3.2.21

FIGURE 3.2.20 Nigerian powdered glass beads.

FIGURE 3.2.21 Three cylindrical coral beads. The larger bead on the left has been made from bamboo coral skeleton and dyed. The two smaller and darker coloured beads have been made from red coral (Coralliidae) and are naturally coloured. Note that the longitudinal lines are much finer in the red coral beads.

FIGURE 3.2.22

FIGURE 3.2.23

FIGURE 3.2.22 A carving made from African elephant (*Loxodonta africana*) ivory.

FIGURE 3.2.23 Beads made from pieces of dyed spiny oyster (*Spondylus*) shell.

3.2.1 Jointed Coral
Isis hippuris Linnaeus, 1758

(A)

(B)

FIGURE 3.2.1.1 (A) a clean, dried piece of jointed coral skeleton; and **(B)** a close-up view showing the characteristic morphology consisting of calcareous internodes and gorgonin nodes.

Other Common Names

See section 3.2 Bamboo Coral for a list of common names used generically for bamboo corals of all types (including *I. hippuris*).

Taxonomy

Isis is probably a monotypic genus containing only the species *I. hippuris*. The only other possible species in the genus is *I. reticulata* which is generally thought to be based on a description of a specimen of *I. hippuris* with an unusual growth form (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, April 10, 2011). The classification of the species, sourced from Fabricius and Alderslade (2001), and van Ofwegen (2010b), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Alcyonaria (=Octocorallia)
ORDER Alcyonacea Lamouroux, 1816
SUBORDER Calcaxonia Grasshoff, 1999
FAMILY Isididae Lamouroux, 1812
GENUS *Isis* Linnaeus, 1758
SPECIES: *I. hippuris* Linnaeus, 1758

Distribution

- *I. hippuris* has been recorded from Australia (the Great Barrier Reef), India (the Andaman Islands), Indonesia, Japan (the Ryukyu Islands), Palau, Papua New Guinea, Philippines, and Taiwan where it is common and widely distributed coral in shallow waters (Anon, 2011; Fabricius and Alderslade, 2001).

Multinational Conservation Status

- As of 2010, *I. hippuris* had not been assessed in the IUCN Red List of Threatened Species or listed in the Appendices of CITES, and there was no international regulation of trade in the species.

- See section 3.2 Bamboo Coral for a discussion of the multinational conservation of the family Isididae (including *I. hippuris*).

Characteristics

- Colonies of *I. hippuris* are branched in an irregular lateral fan-like manner (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, March 4, 2011). Colonies may be sparingly or densely branched. Typically the branches are short, but some colonies have long whip-like branches (Fabricius and Alderslade, 2001).

- Colonies of *I. hippuris* are characterized, as are all species of Isididae, by a skeleton consisting of calcareous internodes (composed of calcium carbonate) interspersed with nodes of proteinaceous gorgonin (SEE SECTION 3.2 BAMBOO CORAL) **(FIGURE 3.2.1.1)**.

- The nodes of *I. hippuris* are much thinner than the internodes. As a result, the internodes tend to appear "bulging" compared to the nodes (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, April 9, 2011), and may be globular or barrel-shaped **(FIGURES 3.2.1.1–3.2.1.4)**.

- The surface of the calcareous internodes of *I. hippuris* exhibits conspicuous parallel longitudinal ridges approximately 1 mm apart. Once the coral is polished, these ridges are typically still evident as longitudinal lines in the material **(FIGURES 3.2.1.5–3.2.1.6)**. In cross-section under low magnification, these will appear as weak radial lines that cross many concentric lines. These lines are particularly visible in dyed specimens **(FIGURE 3.2.1.7)**.

- The natural colour of the calcareous internodes is white while the gorgonian nodes are dark brown-black (Fabricius and Alderslade, 2001) **(FIGURES 3.2.1.1–3.2.1.2; 3.2.1.8– 3.2.1.10)**.

- See section 3.2 Bamboo Coral for discussion of those features that are characteristic to all species of Isididae (including *I. hippuris*).

FIGURE 3.2.1.2 Close-up views of pieces of jointed coral skeleton.

FIGURE 3.2.1.3
(A) (B)

FIGURE 3.2.1.4

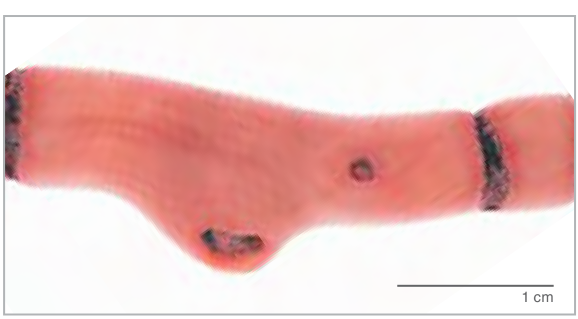
FIGURE 3.2.1.3 (A) a curio consisting of a vase containing pieces of jointed coral set in a clear tinted gel; and **(B)** a close-up view

FIGURE 3.2.1.4 Two sides of a roughly polished and dyed piece of jointed coral skeleton.

(A)

(B)

(C)



(D)

FIGURE 3.2.1.5 Pieces of polished jointed coral skeletons: **(A)** dyed red; **(B)** dyed pink; **(C–D)** close-up views.

FIGURE 3.2.1.6

FIGURE 3.2.1.7

FIGURE 3.2.1.6 A piece of polished and dyed jointed coral skeleton.

FIGURE 3.2.1.7 Close-up cross-sectional views of beads made from pieces of jointed coral skeleton. Traces of the characteristic longitudinal surface ridges may be seen as weak radial lines in the material.

FIGURE 3.2.1.8 1 cm

FIGURE 3.2.1.9 1 cm

(A)

1 cm

(B)

FIGURE 3.2.1.8 a polished, natural coloured bead made from jointed coral skeleton.

FIGURE 3.2.1.9 A barrel-shaped bead made from a piece of jointed coral skeleton that has been dyed red. The bead has been split in half to show that **(A)** the dye coloured the outer surface; and **(B)** did not penetrate to the interior.

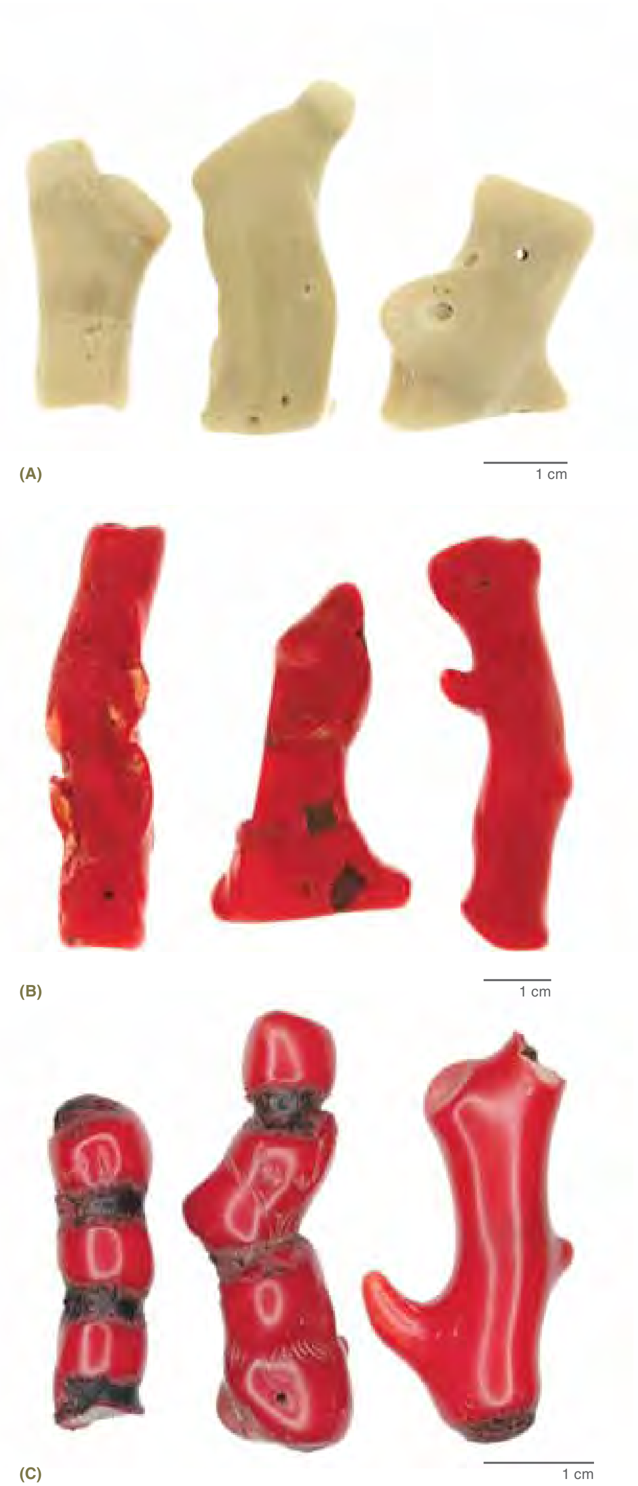


FIGURE 3.2.1.10 Examples of polished, organically-shaped beads made from jointed coral skeleton that show a wide variety of shapes and remnants of gorgonin: **(A)** naturally coloured; **(B-C)** dyed. Note that in some of these pieces the nodes have been overgrown with internodal calcium carbonate.

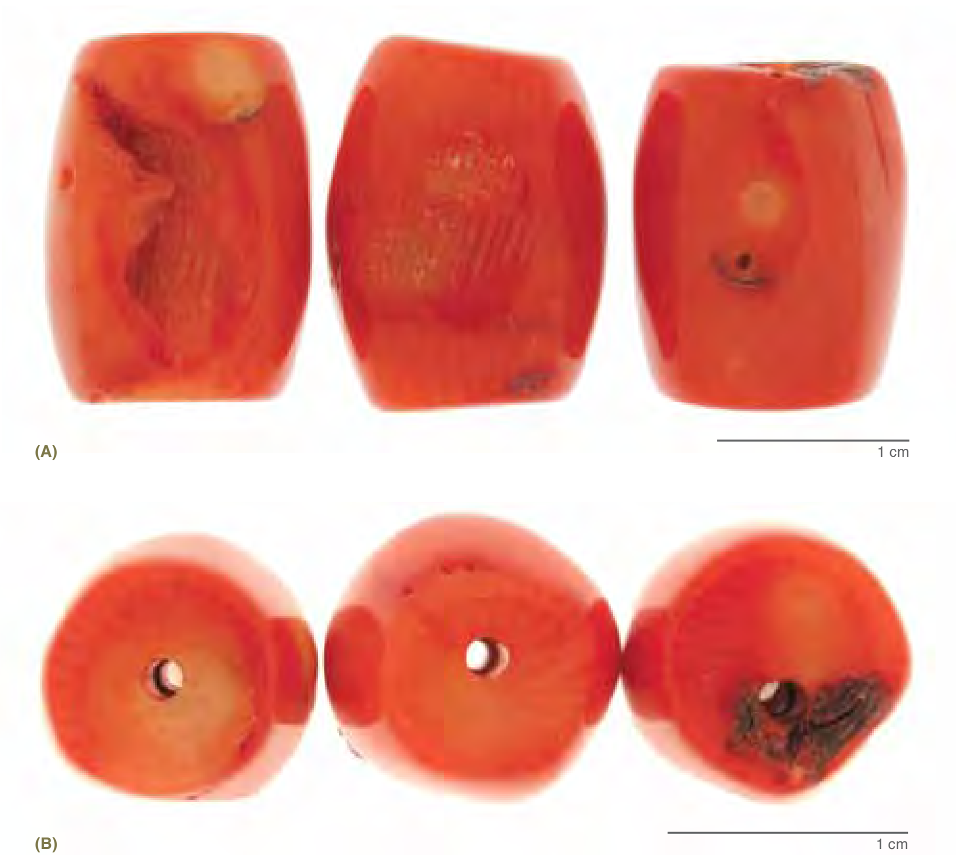


FIGURE 3.2.1.11 Three polished and dyed barrel-shaped beads made from jointed coral skeleton: **(A)** side view; and **(B)** cross-sectional view.

FIGURE 3.2.1.12
(A) **(B)**

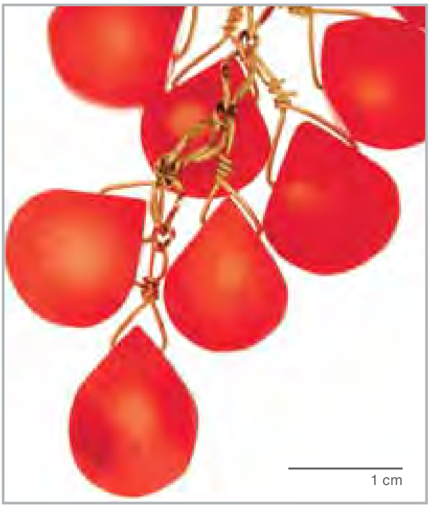


FIGURE 3.2.1.13
(A) **(B)**

FIGURE 3.2.1.12 (A) a polished and dyed carving made from the base of a jointed coral skeleton; and **(B)** a close-up view.

FIGURE 3.2.1.13 (A) a necklace made with dyed jointed coral beads; and **(B)** a close-up view.

FIGURE 3.2.1.14
(A)

(B)

FIGURE 3.2.1.15
(A)

(B)

FIGURE 3.2.1.14 (A) a necklace made with dyed jointed coral beads; and **(B)** a close-up view.

FIGURE 3.2.1.15 (A) a necklace made from dyed jointed coral which includes small, irregularly-shaped beads and large beads made from cross-pieces of skeletons; and **(B)** close-up view.

Trade

- The skeletons of *I. hippuris* are commonly used for the creation of figurines, beads and jewellery **(FIGURES 3.2.1.11–3.2.1.15)**. See section 3.2 Bamboo Coral for discussion of the uses of Isididae skeletons (including *I. hippuris*).

Similar Products

- Coralliidae have striations similar to those of *I. hippuris*. However, the striations of Coralliidae corals are much finer—being approximately 0.25 to 0.5 mm apart (Pedersen, 2004; O'Donoghue, 2006; Smith *et al.,* 2007). Coralliidae are most commonly (but not always) a natural shade of red in colour, whereas the internodes of *I. hippuris* are naturally white—but may be dyed different colours (often to imitate Coralliidae). Unlike Isididae, Coralliidae do not have gorgonin nodes **(FIGURE 3.2.21)** (SEE ALSO SECTIONS 3.2 BAMBOO CORAL AND 3.6 RED AND PINK CORAL).

- Plastic items may exhibit the same colours and glossiness as products made from Isididae **(FIGURE 3.2.1.16)**. However, plastic is not cool to the touch, lacks the characteristic longitudinal ridges or lines and gorgonin nodes of skeletons of Isididae (Pedersen, 2004), and can be readily scratched or damaged.

- See section 3.2 Bamboo Coral for discussion of other products in trade that may be similar to items made from Isididae skeletons (including *I. hippuris*).

(A)

1 cm

(B)

1 cm

FIGURE 3.2.16 Plastic pushpins made to imitate jointed coral: **(A)** front view; and **(B)** back view. Compare with the examples in **FIGURE 3.2.1.10**.

3.3

BLACK CORAL

Antipatharia

3.3 Black Coral
Antipatharia Milne-Edwards & Haime, 1857

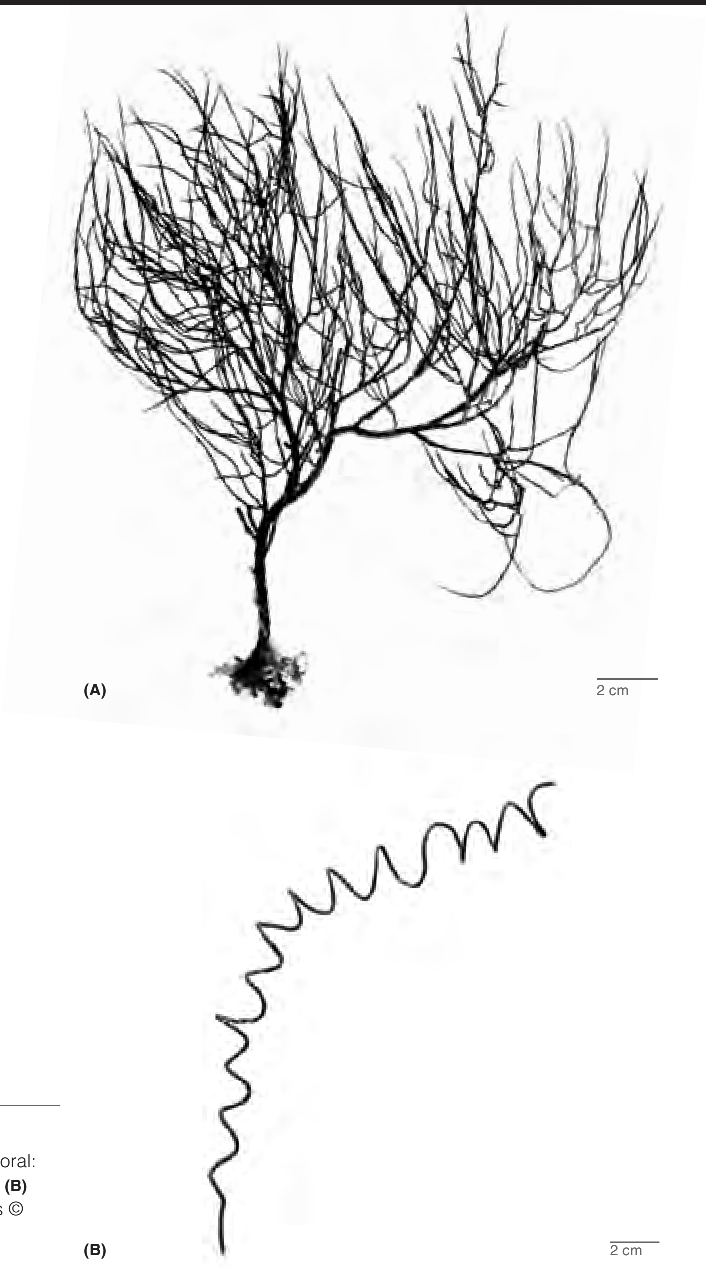


FIGURE 3.3.1 Examples of dried skeletons of black coral: **(A)** *Antipathes griggi;* and **(B)** *Cirrhipathes*. Photographs © Dennis Opresko.

Other Common Names

ENGLISH	Black sea coral; black sea fan; black sponge coral; black whip coral; gold coral; golden coral; golden coral; gold sea coral; kings coral; prickle coral; thorny coral; wire coral
FRENCH	Corail noir
JAPANESE	Kuro sango
SPANISH	Abanico anaranjado; cepillo de botel coral de lanza; coral negro coral redecilla; coral ripidio; matojo negro de mar; pluma de mar

Taxonomy

According to Daly *et al.* (2007) the order Antipatharia includes seven families, seven subfamilies, 40 genera, and 235 species. Daly *et al.* (2007) also noted that approximately 25 percent of the species were described in the past 20 years. Bruckner *et al.* (2008) noted that there is considerable confusion regarding the taxonomy of species of black corals. The classification of the order, according to Fautin and Romano (2000), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Zoantharia de Blainville, 1830 (=Hexacorallia)
ORDER Antipatharia Milne-Edwards & Haime, 1857

Distribution

- Antipatharia are widespread in tropical and subtropical waters below 20 metres in depth (Dixon, 1985). They may be found as shallow as five metres and as deep as 8,000 metres, but are most abundant in tropical waters from 30–80 m depth (Bruckner *et al.,* 2008).

Box 3.3 Note Regarding Antipatharia

It is very difficult to identify black corals. In most cases identification to genus or species is possible only if an entire colony is available. Worked products often cannot be identified beyond the order Antipatharia (e.g. not to family or genus) and identification of heavily worked products such as rings may not be possible without irreparably damaging the item.

Multinational Conservation Status

- As of 2010, no species of Antipatharia had been assessed in the IUCN Red List of Threatened Species. However, the exploitation of, threats to, and proposed conservation measures for the order Antipatharia were discussed in the IUCN Invertebrate Red Data Book (Wells *et al.,* 1983).

- The order Antipatharia was added to CITES Appendix II in 1981 (UNEP-WCMC, 2010).

- As of 2010, the order Antipatharia was listed on Annex B of the EC Wildlife Trade Regulations (*Commission Regulation (EU) No 709/2010 on amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein*) (Anon., 2010).

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Antipatharia (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of Antipatharia in waters outside of their respective exclusive economic zones.

Characteristics

- Colonies of Antipatharia exhibit a variety of forms and branching structures. Some species have long and straight or spirally twisted unbranched stems whereas others may branch in all directions like a shrub or branch in a single plane to form a fan-shaped structure (Dixon, 1985; Hickson, 1924) **(FIGURE 3.3.1)**.

- The skeleton of Antipatharia is not composed of the aragonite or calcium carbonate commonly associated with other corals (Pedersen, 2004). Skeletons of Antipatharia consist of laminated composites, composed primarily of protein, chitin and antipathin (Ehrlich, 2010; Goldberg, 1991; Kim *et al.,* 1992). Although solid and hard enough to be polished, they are also flexible and thermoplastic (can be bent and moulded while being heated). The skeleton of Antipatharia softens at a temperature of 100–150 degrees Celsius (O'Donoghue, 2006; Kim *et al.,* 1992). Since the coral's skeleton is not composed of calcium carbonate, it is not noticeably cool to the touch.

- In living colonies the tissues may or may not be coloured and may be translucent or opaque. On dry specimens—if the tissue remains on the skeleton—the colour fades away and the tissue is usually opaque and white (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, February 17, 2011) **(FIGURE 3.3.2)**.

- The colour of the skeleton of black corals commonly used to make jewellery is dark brown to black (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, December 18, 2010) **(FIGURES 3.3.3–3.3.4)**. Typically therefore, worked products made from Antipatharia usually appear opaque and black in colour under direct light (O'Donoghue, 2006). However, thin sections viewed through transmitted light appear reddish-brown and translucent (O'Donoghue, 2006) (**FIGURE 3.3.5)**. Dixon (1985) suggests that scrapings of black coral may appear reddish-brown.

Characteristics (continued)

- Not all genera of Antipatharia are black in colour. For example specimens of *Aphanipathes* may be light brown in colour and fibrous in texture—appearing similar to wood. However, these are not commonly used for jewellery (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, December 18, 2010).

- When immersed in a 30 percent solution of hydrogen peroxide, the surface of a specimen of Antipatharia is oxidized and turns a bright shiny gold colour (Brown, 1988), presumably through the formation of iodine dioxide (E. Espinoza, National Fish and Wildlife Forensics Laboratory, *in litt.* to E. Cooper, Oct. 13, 2010) **(FIGURE 3.3.6)**. The authors found that immersion in a 50 percent hydrogen peroxide solution for 80 minutes yielded good results (SEE SECTION 2.0 METHODS) **(FIGURES 3.3.7–3.3.8)**. Other corals and those substances used to imitate Antipatharia do not react to hydrogen peroxide in this way. Hence, immersion in 30–50 percent hydrogen peroxide appears to be a test for identifying items made from Antipatharia. The change in colour cannot be reversed, so care should be exercised before this method is used on valuable items.

- The surface of the skeleton of Antipatharia is characterized by the presence of small (less than 0.5 mm tall) spines that are found on all sides of the branches **(FIGURE 3.3.9–3.3.10)** and often in distinct rows extending along the length of the skeleton (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, February 17, 2011). These spines are absent amongst other orders of corals (Bruckner *et al.,* 2008; Hickson, 1924; O'Donoghue, 2006). These minute spines may be visible only under magnification and give the skeleton a sandpaper-like feel when touched. In many cases, the spines are absent on the thicker branches and can only be found on the finer tips of the branches (Hickson, 1924; Pedersen, 2004). This is true of the genus *Leiopathes* which is found in deep water in all oceans except the Arctic and Antarctic. The skeleton is usually jet black and solid in texture, and the stem can be very thick—

Characteristics (continued)

several inches or more. Hence this species is very good for making jewellery. Identifying products made from *Leiopathes* as black coral may be difficult as spines are only found on the smallest branches and not on the main stem (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, December 18, 2010).

- The spines of Antipatharia are typically absent from finished products as a result of the polishing process **(FIGURE 3.3.11)**. However, under oblique lighting, it is often possible to see dots or dimples in the surface identifying where spines were prior to removal (O'Donoghue, 2006). The remnants of spines are particularly easy to see on specimens that have been transformed to a gold colour using hydrogen peroxide **(FIGURE 3.3.6)**.

- The stem and branches of Antipatharia are formed by skeletal material made of protein and chitin arranged in a number of concentric layers around a central circular cavity (Hickson, 1924; Goldberg, 1991). In cross-section this resembles a section of a tree trunk with the concentric layers appearing comparable to the annual rings of wood (Hickson, 1924) **(FIGURE 3.3.12)**.

- If subjected to a hot-point test (e.g. touched with a red-hot needle), the skeleton of Antipatharia will burn and produce a smell similar to that of burning hair.

- The genera most commonly used to make jewellery are *Antipathes*, *Stichopathes*, and *Cirrhipathes*. The skeleton colour of these corals is dark brown to black. Species of these genera are found especially in tropical and subtropical areas, and some may occur within SCUBA diving depths. *Antipathes* forms multi-branched colonies whereas *Stichopathes* and *Cirrhipathes* form unbranched whip-like colonies which may be straight or coiled. In the latter state, sections can easily be shaped into bracelets, rings and other types of ornaments (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, December 18, 2010).

(A)

(B)

FIGURE 3.3.2 (A) pieces of dried black coral (*Antipathes*) skeletons that have been cut to size for use in the manufacturing of coral jewellery; and **(B)** a close-up view of one piece. Note that the specimens have not been cleaned of dried tissue and encrusting material.

(A)

(B)

FIGURE 3.3.3 (A) a piece of dried black coral (*Antipathes*) skeleton that has been cut to size for use in the manufacturing of coral jewellery; and **(B)** a close-up view. This specimen has been cleaned of dried tissue and encrusting material.

FIGURE 3.3.4 Pieces of cleaned, dried black coral skeletons that have been cut to size for use in the manufacturing of coral jewellery.

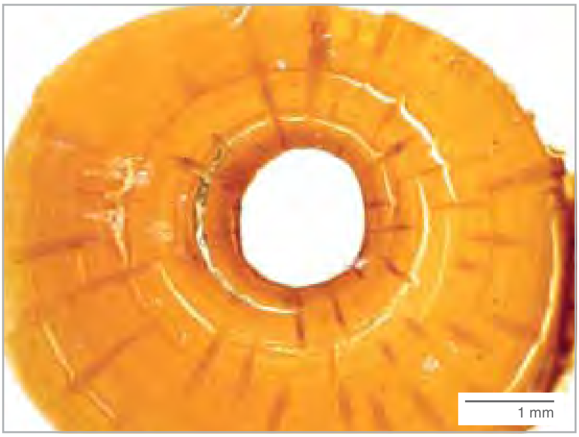


FIGURE 3.3.5

FIGURE 3.3.6
(A)

(B)

FIGURE 3.3.5 Thin section of a piece of black coral (*Cirrhipathes*) skeleton viewed through transmitted light. The dark lines radiating outward are the spines. Photograph © Angela Leung/WWF-Canada.

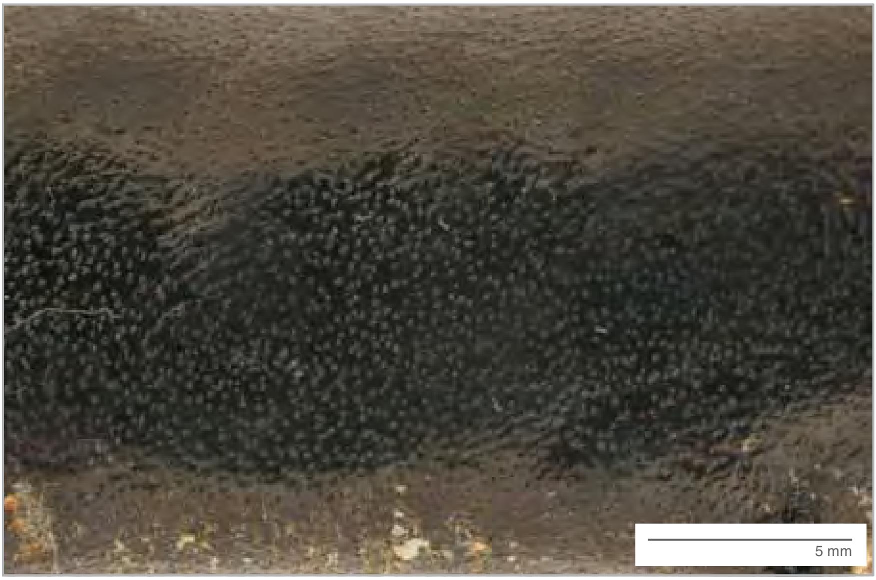
FIGURE 3.3.6 Beads made from short pieces of black coral (*Cirrhipathes*) skeletons: **(A)** naturally coloured; and **(B)** oxidized to a gold colour via immersion in hydrogen peroxide.

FIGURE 3.3.7
(A) **(B)**

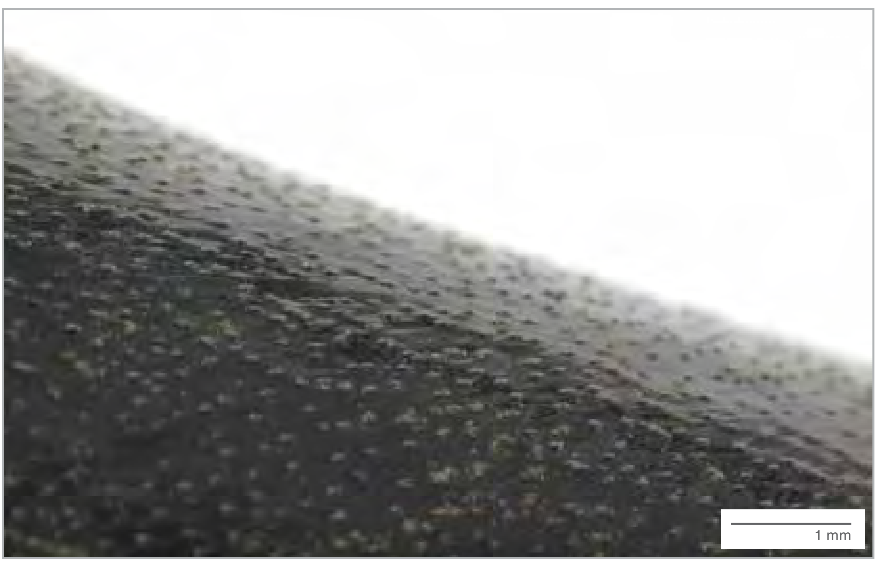
FIGURE 3.3.8
(A) **(B)**

FIGURE 3.3.7 Close-up views of beads made from short pieces of black coral (*Cirrhipathes*) skeletons: **(A)** naturally coloured; and **(B)** oxidized to a gold colour via immersion in hydrogen peroxide. Note that one end of the upper bead in image **(B)** was not submerged in hydrogen peroxide and retained its natural black colour.

FIGURE 3.3.8 Two close-up views of a cross-section of black coral skeleton: **(A)** before immersion in hydrogen peroxide; and **(B)** after immersion in 50% hydrogen peroxide solution for 80 minutes.



(A)



(B)

FIGURE 3.3.9 (A–B) close-up views of the surface of cleaned, dried black coral skeletons showing the characteristic minute surface spines.

(D)

FIGURE 3.3.10 Close-up views of pieces of cleaned, dried black coral skeletons that exhibit the characteristic minute surface spines: **(A–C)** naturally coloured; **(D)** after immersion in 50% hydrogen peroxide solution for 80 minutes.

FIGURE 3.3.11

1 cm

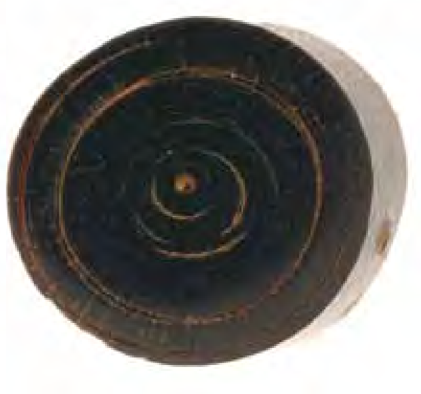


FIGURE 3.3.12

(A) 1 cm

(B) 1 cm

FIGURE 3.3.11 A piece of cleaned, dried black coral skeleton. The upper surface has been polished while the lower has not and still retains characteristic minute surface spines.

FIGURE 3.3.12 Cross-sections of black coral skeletons showing the concentric layers and resemblance to a section of a tree trunk: **(A)** cross-section of an unpolished basal portion of a skeleton; and **(B)** cross-section of a polished piece of skeleton.

Trade

- Antipatharia is traded mainly as figurines, jewellery **(FIGURES 3.3.13–3.3.16)** and raw coral. According to UNEP-WCMC (2010) there is also limited trade in live colonies.

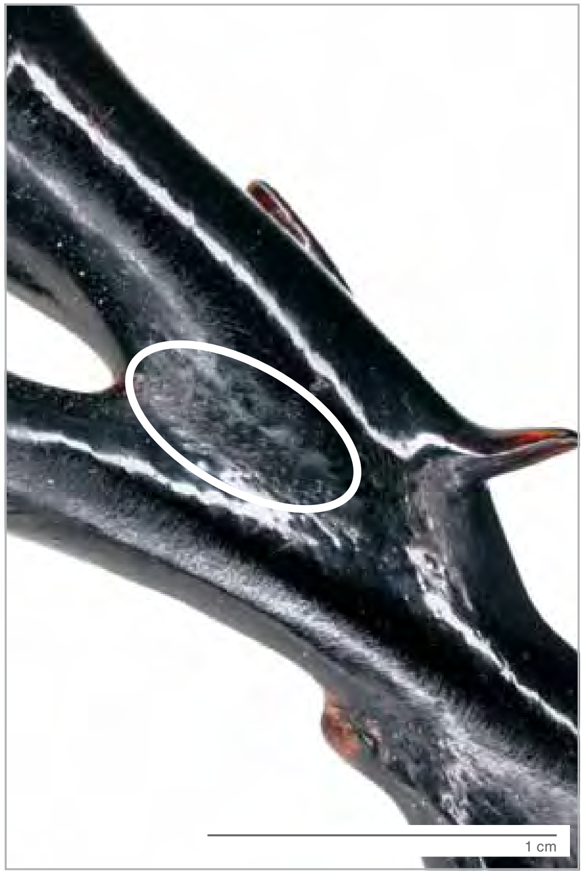
- International trade has been reported for 11 genera of Antipatharia. For four of these genera, trade has been reported for 13 species. Over 90 percent of the trade records are for Antipatharia spp., *Antipathes* spp., and *Cirrhipathes* spp. *Cirrhipathes anguina* and *Antipathes densa* were the species most commonly reported in trade (Bruckner *et al.,* 2008). However, although *C. anguina* is known to be a commonly traded species, the trade data for *A. densa* is suspect since the species it is not common in museum collections and does not get to a very large size. Most likely, *Antipathes curvata*, *A. caribbeana*, *A. griggi*, *A. grandis* and other related species are the mostly commonly traded taxa (the latter two being harvested legally in Hawaii) (D. Opresko, Smithsonian Institution, *in litt.* to E. Cooper, June 8, 2011).

- The main species that is harvested in Hawaii and Tonga is *Antipathes griggi* (formerly *A. dichotoma*). This may be the most common species harvested in the Pacific Ocean (R. Grigg, University of Hawaii, *in litt.* to E. Cooper, February 9, 2011).

- *Cirrhipathes* is considered to be of inferior quality (Bruckner *et al.,* 2008). Due to its lower quality and value, *Cirrhipathes* is often bleached in hydrogen peroxide (see above) and marketed as “gold” or “golden” coral **(FIGURES 3.3.6** and **3.3.16)**.

(A)

(B)



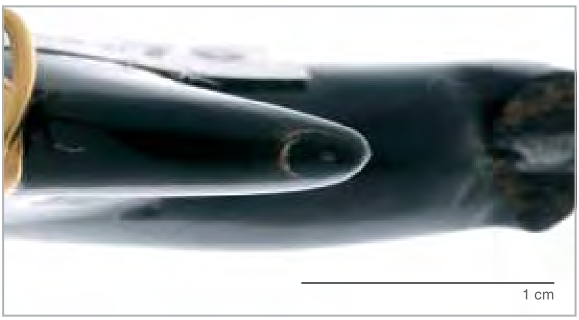
(C)

(D)

FIGURE 3.3.13 (A) a figurine carved from a black coral skeleton; **(B)** close-up view of the carving; and **(C)** close-up view of a small unpolished area (encircled in white) that still retains remnants of the characteristic minute surface spines; and **(D)** close-up view of the upper end of the figurine showing the concentric layers.

FIGURE 3.3.14 Jewellery made from pieces of black coral (*Antipathes griggi or A. grandis*) skeleton inset into gold: **(A)** earrings; **(B)** fitted rings; and **(C)** a coral and diamond pendant. Photograph © Maui Divers Jewelry.

FIGURE 3.3.15
(A)



(B)

FIGURE 3.3.16

FIGURE 3.3.15 (A) a carved pendant of a dolphin (with a broken tail) made from black coral skeleton; and **(B)** a close-up view of the upper side of the dorsal fin (note the concentric layers).

FIGURE 3.3.16 Earrings made from "golden coral": black coral (*Cirrhipathes*) beads that have been oxidized to a gold colour via immersion in hydrogen peroxide.

Similar Products

- Products made from black plastic may simulate the colour of Antipatharia **(FIGURE 3.3.17)**, however, plastic will typically be softer in consistency and easier to scratch, and will not exhibit any evidence of growth rings or the spines characteristic of Antipatharia. A hot-point test on plastic will produce the smell of burning plastic or sour milk, and not the burnt-hair smell characteristic of burnt Antipatharia. In addition, plastic will not turn gold when immersed in hydrogen peroxide.

- Polished jet could be mistaken for polished black coral **(FIGURE 3.3.18)**. However, jet will not exhibit evidence of growth rings or spines and will not turn gold when immersed in hydrogen peroxide. A hot-point test will yield the smell of burning coal (O'Donoghue, 2006).

- Black glass beads may be similar in appearance to products made from Antipatharia as they are smooth and hard and may exhibit a similar level of polish and lustre **(FIGURE 3.3.19)**. However, glass is cool to the touch and is heavier than similar-sized pieces of Antipatharia. Glass will not exhibit any evidence of growth rings or spines and will not react to a hot-point test or immersion in hydrogen peroxide. In addition, glass beads may contain air bubbles and other flaws (Pedersen, 2004).

- Hard, dense woods such as uli or mangrove wood may be used to simulate black coral (E. Espinoza, National Fish and Wildlife Forensics Laboratory, pers. comm. to E. Cooper, April 22, 2010). The growth rings of wood may be very similar to those of Antipatharia, but wood will not exhibit evidence of surface spines. A hot-point test will produce the smell of burning wood, and wood will not turn gold when immersed in hydrogen peroxide.

Similar Products (continued)

- Whole, dried shallow-water gorgonians (families Gorgoniidae and Plexauridae) are often traded as colonies of Antipatharia. These gorgonians are common in the Caribbean and Indo-West-Pacific (A. Bruckner, Living Oceans Foundation and R. Grigg, University of Hawaii, *in litt.* to E. Cooper, Sept. 9, 2010). The axis of these organisms is black, tough and flexible and may appear very similar to that of Antipatharia[4] **(FIGURES 3.3.20–3.3.21)**. However, these gorgonians do not have the spines characteristic of Antipatharia and will not turn gold when immersed in hydrogen peroxide **(FIGURE 3.3.22)**.

- *Gerardia* (Hawaiian gold coral) skeletons exhibit growth rings like those of Antipatharia, and have a similar texture and consistency. Polished specimens of *Gerardia* are a golden colour that looks much different from specimens of Antipatharia; plus skeletons of *Gerardia* do not have the spines characteristic of Antipatharia and instead have a surface texture that is very finely dimpled **(FIGURE 3.3.23)**.

    - Specimens of *Gerardia* may be distinguished from "golden coral" (pieces of Antipatharia that have been turned gold in colour through immersion in hydrogen peroxide) primarily by surface texture: "golden coral" typically shows the remnants of the spines characteristic to Antipatharia **(FIGURE 3.3.23)**.

[4]There are two unusual and rare gorgonian genera that have spines. Their skeletons are also unusual and their spines do not resemble those of Antipatharia. See Opresko and Bayer (1991) and van Ofwegen and McFadden (2010) for descriptions. Neither genus is found in trade.

FIGURE 3.3.17 1 cm

FIGURE 3.3.18

FIGURE 3.3.19

FIGURE 3.3.17 A plastic imitation black coral pendant.

FIGURE 3.3.18 Spherical beads made from jet.

FIGURE 3.3.19 Spherical beads made from black glass.

(A)

(B)

FIGURE 3.3.20 (A) a dried gorgonian (Gorgoniidae or Plexauridae) skeleton; and **(B)** close-up view of a branch.

FIGURE 3.3.21 (A) a dried gorgonian (Gorgoniidae or Plexauridae) skeleton; **(B)** a close-up view of the branches; and **(C)** a close-up view of the surface of a branch.

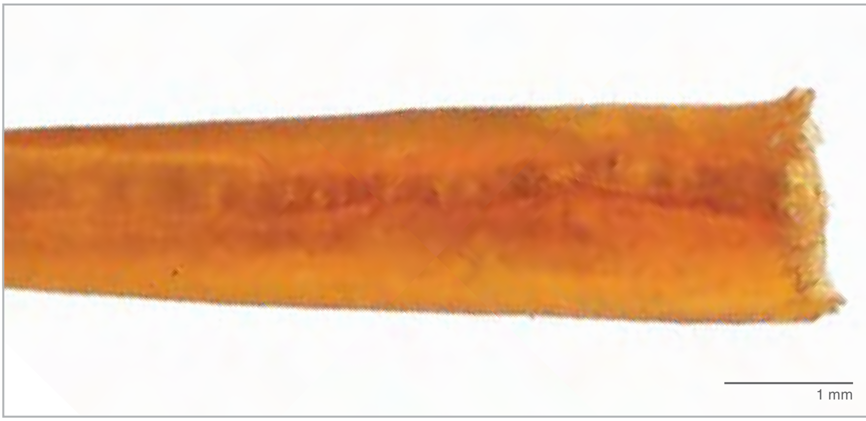


FIGURE 3.3.22

FIGURE 3.3.23

FIGURE 3.3.22 A close-up view of a small piece of a dried gorgonian (Gorgoniidae or Plexauridae) skeleton that has been immersed in hydrogen peroxide. Note that the sample has become translucent rather than turning gold like black coral (Antipatharia) that is similarly treated.

FIGURE 3.3.23 Comparison of pieces of the skeleton of **(A)** Hawaiian gold coral (*Gerardia*); and **(B)** black coral (*Cirrhipathes*) that has been oxidized to a gold colour via immersion in hydrogen peroxide.

3.4

BLUE CORAL

Heliopora coerulea

3.4 Blue Coral
Heliopora coerulea (Pallas, 1766)

(A)

(B)

FIGURE 3.4.1 (A) a whole dried blue coral colony; and **(B)** a close-up of one lobe.

Other Common Names

ENGLISH	Blue ridge coral; blue sponge coral; denim coral; heliopora; sponge coral
FRENCH	Corail bleu
JAPANESE	Ao sango
SPANISH	Coral azul

Taxonomy

Heliopora is a monotypic genus (having only one species). The classification of the species, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Alcyonaria (=Octocorallia)
ORDER Helioporacea
FAMILY Helioporidae Moseley, 1876
GENUS *Heliopora* de Blainville, 1830
SPECIES *H. coerulea* (Pallas, 1766)

Synonyms

Heliopora compressa, *Madrepora coerulea* (UNEP-WCMC, 2010)

Distribution

- *Heliopora* is found throughout the Indo-Pacific region (Obura *et al.,* 2008). Harii and Kayanne (2001) note that it is uncommon in most of its range whereas Obura *et al.* (2008) state that it is locally common within its range. The largest known colonies are found in Japan (Bruckner, 2002).

- According to Obura *et al.* (2008), this species is found in shallow reefs (usually in depths of less than two metres), exposed reef locations, reef flats and intertidal zones.

Multinational Conservation Status

- *Heliopora* was listed on CITES Appendix II in 1985 (UNEP-WCMC, 2010). Fragments of *Heliopora* that can't be identified to genus are considered exempt from the provisions of CITES through two resolutions agreed to by the Parties: Resolution Conf. 9.6 (Revised) and Resolution Conf. 11.10 (Revised CoP 15) (CITES, 1994; CITES, 2000). However, given the distinctive characteristics of *Heliopora,* it seems unlikely that any fragment large enough to be used in jewellery would be unidentifiable. Fossil stony coral (including *Heliopora*) is specifically noted as not being subject to the provisions of the Convention (CITES, 2000; CITES, 2010) (SEE ADDITIONAL COMMENTS IN SECTION 3.8.2 FOSSIL CORAL). However, during the course of researching and preparing this guide, no specimens of fossil *Heliopora* were noted in trade.

- As of 2010, *Heliopora* was listed on Annex B of the EC Wildlife Trade Regulations (*Commission Regulation (EU) No 709/2010 on amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein*) (Anon., 2010).

- *Heliopora* was assessed in 2008 in the IUCN Red List of Threatened Species as "Vulnerable" under Criterion A4cde. (Obura *et al.,* 2008).

Characteristics

- Colonies are typically composed of multiple columns and vertical flat plates and can extend to over one metre in diameter (Bruckner, 2002). They can also occur as flat horizontal plates (Oliver, 1986a). The tips of branches are generally blunt and lobed (Hickson, 1924) **(FIGURES 3.4.1–3.4.2)**.

- The skeleton of *Heliopora* is composed of fibrous aragonite (a naturally occurring crystal form of calcium carbonate) (Zann and Bolton, 1985).

- Living colonies are brown in colour (Bruckner, 2002). The surface of dead specimens may be coated with the remains of tissue and therefore appear brownish in colour **(FIGURE 3.4.3)**.

- The exterior of a cleaned skeleton is grey-blue in colour while the interior is deep blue (Oliver, 1986a) **(FIGURES 3.4.3–3.4.4)**. Specimens exposed to sunlight for extended periods of time may be bleached to a light grey. The natural colour of the coral may be enhanced with dye for commercial purposes (Pedersen, 2004) **(FIGURE 3.4.2)**. The dye may be particularly evident in pores and other concavities.

- The surface of a cleaned skeleton is smooth and porous with two distinctly different sizes of circular pores **(FIGURE 3.4.5)**. The smaller pores are significantly more numerous and have a diameter of approximately 0.1 millimetres. The larger pores are the openings of the corallites (from which the feeding polyps emerge), which are tubular and have a diameter of approximately 1.0 millimetre (Bruckner, 2002; Hickson, 1924; Nicholson, 1870). In some specimens pores of a third type may be observed which have been formed by borrowing polychaete worms and are not features of the natural skeleton **(FIGURE 3.4.6)** (Bourne and Lankester, 1894; Eguchi, 1948; Hickson, 1924).

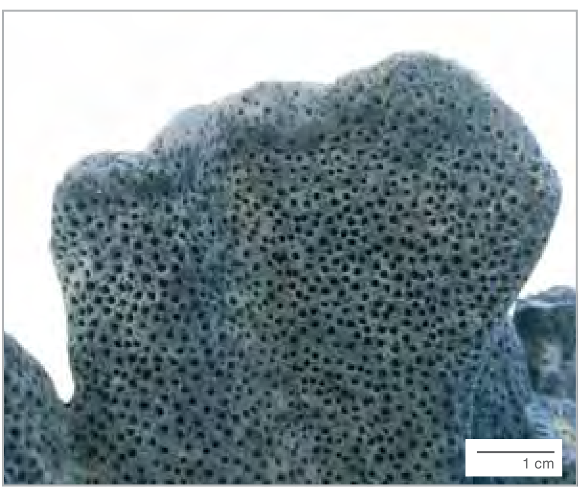
Characteristics (continued)

- The surface of a skeleton typically has a matte and chalky appearance (Pedersen, 2004). Heavily processed products (e.g. beads) may appear polished due to the characteristic pores being filled with dust. However, the pores will still be visible **(FIGURES 3.4.7–3.4.8)**.

- Products may appear polished if they are first impregnated with a stabilizing resin. Impregnated coral will feel smooth to the touch as the characteristic pores will be filled, although still visible, and the coral will have a sheen rather than a matte finish. Drips of resin and/or bubbles may be present **(FIGURE 3.4.9)** (Pedersen, 2004).

- A hot-point test on a clean specimen of *Heliopora* will produce no significant result. However, a hot-point test on a specimen that has been impregnated with resin will produce a sweet/plastic or chemical smell.

(A)

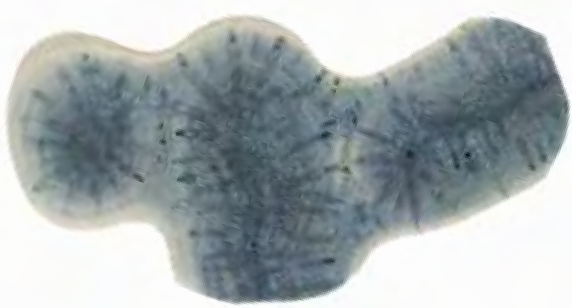


(B)

FIGURE 3.4.2 (A) a whole dried blue coral colony; and **(B)** a close-up of one lobe. This specimen has had its surface abraded and has been dyed to intensify the blue colour.

FIGURE 3.4.3

FIGURE 3.4.4
(A)



(B)

FIGURE 3.4.3 A cross-section of a blue coral skeleton that still has the remains of brownish tissue on the outer surface

FIGURE 3.4.4 (A–B) Cross-sections of blue coral skeletons showing characteristic colours and texture.

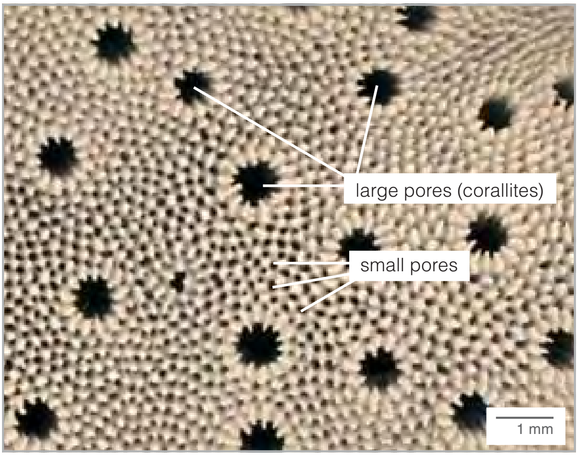


FIGURE 3.4.5

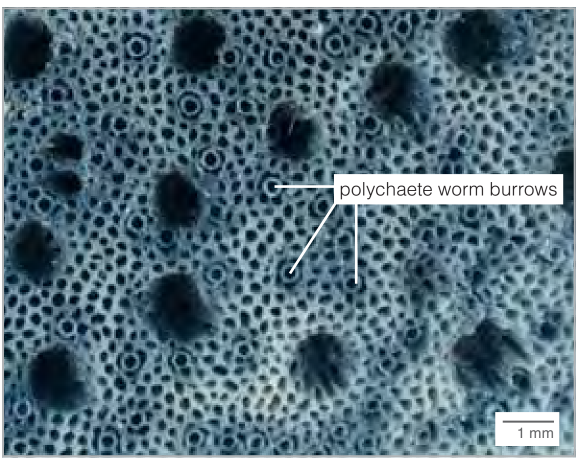
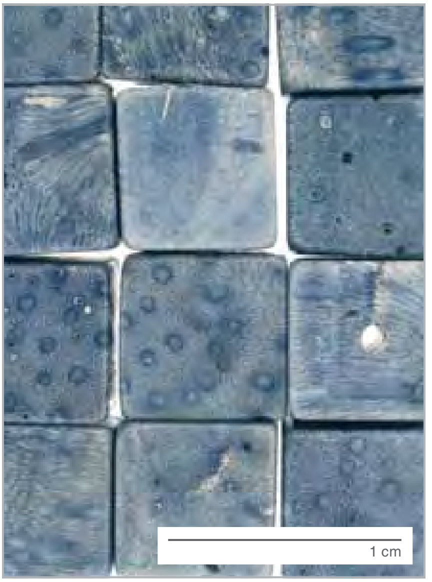


FIGURE 3.4.6

FIGURE 3.4.5 A close-up view of the surface of a clean, dried blue coral skeleton showing the characteristic large (corallites) and small pores.

FIGURE 3.4.6 A close-up view of the surface of a clean, dried blue coral skeleton that has been abraded (to smooth the surface) and dyed to intensify the blue colour. In addition to the natural small and large pores, this specimen has a third type of pore that has been formed by burrowing polychaete worms.

(A)



(B)

(C)

FIGURE 3.4.7 Beads made from pieces of blue coral skeleton: **(A)** oval-shaped; **(B)** cubes; and **(C)** spheres. Note that in many cases the characteristic pores have been filled with dust as a result of the manufacturing process.

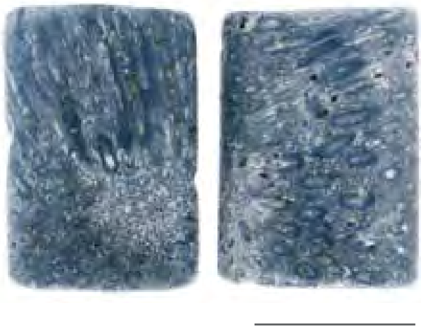
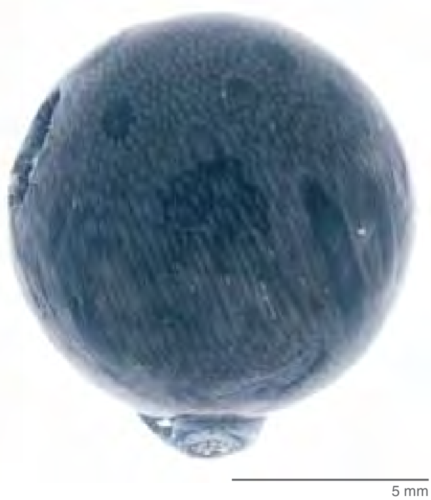


FIGURE 3.4.8
(A)

(B)

FIGURE 3.4.9
(A)



(B)

FIGURE 3.4.8 (A) rough beads made from pieces of blue coral skeleton that are rectangular-shaped; and **(B)** oval in cross-section.

FIGURE 3.4.9 Round beads made from pieces of blue coral: **(A)** polished; and **(B)** impregnated with resin. Note the drip of resin on the impregnated bead.

Trade

- Live colonies of *Heliopora* occur in the aquarium hobbyist trade, and dried skeletons are traded as curios and used for jewellery (UNEP-WCMC, 2010; Obura *et al.,* 2008).

- *Heliopora* is used for jewellery in various forms and may be either unpolished or impregnated with resin and polished (Pedersen, 2004). Finished products include pendants, rings, bracelets and necklaces, etc. **(FIGURES 3.4.10–3.4.14)**.

FIGURE 3.4.10

FIGURE 3.4.11

FIGURE 3.4.10 Three curios shaped from pieces of blue coral skeleton that show significant variation in texture and appearance.

FIGURE 3.4.11 A carved head made from a piece of blue coral skeleton.

FIGURE 3.4.12
(A)

(B)

FIGURE 3.4.13
(A)

(B)

FIGURE 3.4.12 (A) a necklace made with round and oval-shaped blue coral beads; and **(B)** a close-up view of the beads.

FIGURE 3.4.13 (A) a necklace made with cube-shaped blue coral beads; and **(B)** a close-up view of the beads.

FIGURE 3.4.14 a bracelet made with round, oval, and square-shaped blue coral beads.

Similar Products

- Beads made of blue agate and other stones may appear similar to specimens of *Heliopora* but the stones lack the distinctive circular pores and the natural texture of *Heliopora* **(FIGURE 3.4.15)**. Note that a large proportion of blue agate stone is actually dyed (P. Alderslade, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, June 19, 2011). Beads made from lava rock are roughly porous, but do not have distinct circular pores, and are either black or red in colour rather than blue **(FIGURE 3.4.16)**.

- Beads and other products made from Scleractinia (stony coral) may be dyed a blue colour **(FIGURE 3.4.17)**, but the corallites of Scleractinia are dissimilar from the distinctive pores of *Heliopora,* and the colour may be removed by applying a solvent (SEE SECTION 3.8.3 STAGHORN CORAL).

- Products made from *Heliopora* are sometimes advertised and sold as pieces of Melithaeidae (sponge coral) as both taxa have a porous appearance. However, specimens of *Heliopora* may be readily identified by their natural blue colour and distinctive circular surface pores while melithaeid products are reddish in colour and have a sponge-like texture (SEE SECTION 3.7 SPONGE CORAL).

- Products made from plastic may simulate the colour of *Heliopora* but will be lighter in weight, softer in consistency and will not exhibit the characteristic pores of *Heliopora* **(FIGURE 3.4.18)**. A hot-point test on plastic will produce the smell of burning plastic or sour milk, whereas a hot-point test on a clean specimen of *Heliopora* will produce no significant result. However, it is important to note that a hot-point test on a specimen of *Heliopora* that has been impregnated with resin will produce a sweet/plastic or chemical smell.

FIGURE 3.4.15

FIGURE 3.4.16

FIGURE 3.4.15 Beads made from blue agate stone.

FIGURE 3.4.16 Beads made from black lava rock.

FIGURE 3.4.17

FIGURE 3.4.18
(A)

(B)

FIGURE 3.4.17 Beads made from pieces of stony coral (*Acropora*) skeleton that have been dyed blue, possibly to imitate blue coral.

FIGURE 3.4.18 (A) a bracelet made from plastic imitation *Heliopora* beads; and **(B)** a close-up view of the beads.

3.5

HAWAIIAN GOLD CORAL

Gerardia

3.5 Hawaiian Gold Coral
Gerardia Lacaze-Duthiers, 1864

FIGURE 3.5.1

FIGURE 3.5.2
(A) 1 cm
(B) 1 cm

FIGURE 3.5.1 A live colony of Hawaiian gold coral at French Frigate Shoals, Hawaii (350m). Photograph © Hawaii Undersea Research Laboratory: PI-Frank Parrish.

FIGURE 3.5.2 A clean, dried piece of Hawaiian gold coral skeleton: **(A)** side view; **(B)** end view showing a cross-section of the skeleton.

Other Common Names

ENGLISH	Gold coral
FRENCH	Corail hawaïen d'or
SPANISH	Falso coral negro

Taxonomy

The classification of the genus *Gerardia*, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Zoantharia de Blainville, 1830 (=Hexacorallia)
ORDER Zoanthidea
FAMILY Gerardiidae Rocher and Tixier-Durivault, 1951
GENUS *Gerardia* Lacaze-Duthiers, 1864

Distribution

- The genus *Gerardia* is distributed throughout the Hawaiian Archipelago, the Emperor Seamount Chain and the waters of Midway in the Western South Pacific (Parrish and Baco, 2007); the Caribbean (Druffel *et al.,* 1995); the Canary Islands in the Atlantic Ocean; and the Mediterranean Sea (Brito, 1983).

- In Hawaiian waters, colonies of *Gerardia* are found at depths of 300 to 600 m on hard substrates, such as seamounts and ledges, pinnacles, walls, and cliffs (Parrish and Baco, 2007; Roark *et al.,* 2009). *Gerardia* often settles on and grows over other corals (Parrish, 2007).

Box 3.5 Note Regarding *Gerardia*

Hawaiian gold coral is no longer commercially harvested, and is not common in trade. However, heirloom jewellery may be traded internationally, and must be distinguished from items made from *Primnoa* (Alaskan gold coral) or from Antipatharia (black coral) which is sometimes manipulated to imitate pieces of *Gerardia.*

Multinational Conservation Status

- As of 2010, no species of *Gerardia* had been assessed in the IUCN Red List of Threatened Species or listed in the Appendices of CITES, and there was no international regulation of trade in specimens of *Gerardia*.

- Effective September 12, 2008, NOAA's National Marine Fisheries Service (NMFS) implemented a five-year moratorium on the harvesting of gold coral throughout the U.S. western Pacific to prevent overfishing and stimulate research (NOAA, 2008). Based on the data available[5] [in 2009], it is likely the moratorium will be renewed at the end of the five-year period (F. Parrish, Pacific Islands Fisheries Science Center, NMFS/NOAA, *in litt.* to E. Cooper, Oct. 13, 2009).

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[5]Recent research on *Gerardia* has indicated that some colonies may be thousands of years old and thus, highly susceptible to overharvesting (Roark *et al.*, 2006). Parrish (2007) suggests that the recovery of Hawaiian populations of *Gerardia* to pre-exploitation levels is unlikely even over several decades.

Characteristics

- Colonies of *Gerardia* branch in a single plane to form a fan-shaped, tree-like structure, and can grow 2–3 metres high (Parrish and Baco, 2007; Roark *et al.,* 2009) **(FIGURE 3.5.1)**.

- The skeletons of *Gerardia* are proteinaceous in composition, rather than calcareous (Roark *et al.,* 2009). According to Prince and Kheshgi (1996) the protein is similar to collagen and rich in glycine and alanine; but unlike collagen, the skeletons of *Gerardia* are rich in histidine which gives them a unique structure.

- The dried, unpolished skeleton of *Gerardia* is golden in colour, with black overtones, giving it an appearance reminiscent of antique brass **(FIGURES 3.5.2–3.5.3)**. In cross-section it may appear almost black and similar to Antipatharia **(FIGURE 3.5.2)**. When cleaned and polished, the skeleton of *Gerardia* is a lustrous golden colour.

- Although solid and hard enough to be polished, skeletons of *Gerardia* are also thermoplastic (can be bent and moulded while being heated) (Brown, 1979).

- In cross-section, specimens of *Gerardia* exhibit concentric growth rings (Brown, 1979; Grigg, 2002) comparable to the annual rings of wood **(FIGURE 3.5.2)**.

- The surface of a dried skeleton of *Gerardia* is smooth and characterized by a very finely dimpled texture (Brown, 1979; O'Donoghue, 2006) **(FIGURE 3.5.4)**. The fine dimpling is characteristic of *Gerardia* but may be lost on pieces that have been polished.

- If subjected to a hot-point test (e.g. touched with a red-hot needle), the skeleton of *Gerardia* will burn and produce a smell similar to that of burning hair.

FIGURE 3.5.3 (A–C) cleaned, dried pieces of Hawaiian gold coral skeletons; **(D)** a close-up view of specimen **(C)**.

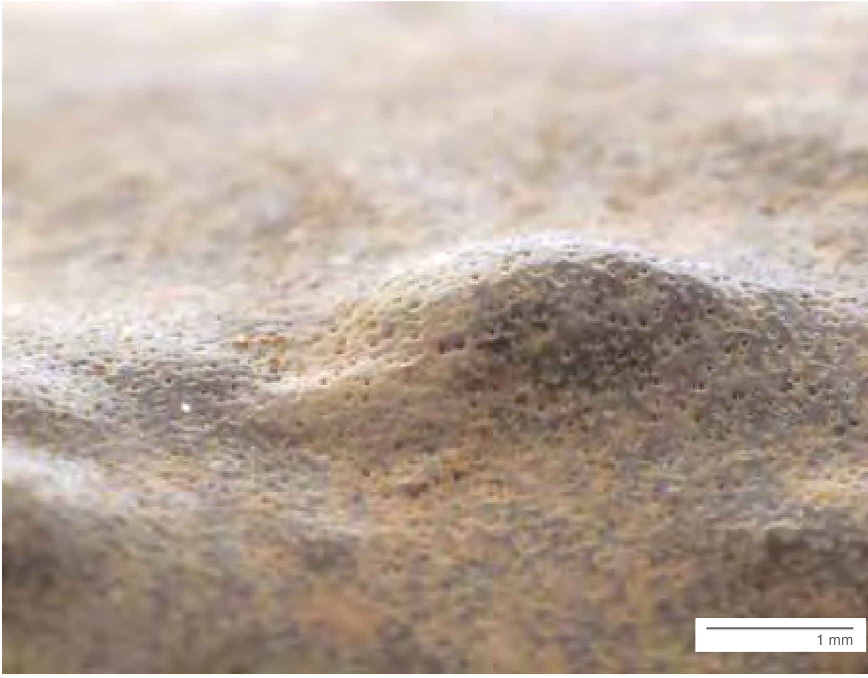


FIGURE 3.5.4 A close-up view of a clean, dried piece of Hawaiian gold coral skeleton showing the characteristic surface texture.

Trade

- The authors could not find any literature that suggested that commercial harvest of *Gerardia* has occurred outside of the waters of Hawaii.

- The skeletons of *Gerardia* and the products made from them are highly valuable. However, unprocessed skeleton material is rare now as it is no longer commercially harvested in Hawaii (J. Tanaka, Maui Divers, pers. comm. to E. Cooper, October 26, 2009). International trade therefore primarily consists of jewellery made from pre-moratorium stock, which may be decades old.

- Finished products include pendants, rings, bracelets, necklaces, etc. **(FIGURE 3.5.5)**.

(A)

(B)

FIGURE 3.5.5 Jewellery made from pieces of Hawaiian gold coral skeleton inset into gold: **(A)** a coral and diamond ring; **(B)** coral and diamond earrings. Photographs © Maui Divers Jewelry.

Similar Products

- Hard, dense woods could be used to simulate specimens of *Gerardia* if the wood was coloured to appear golden. The growth rings of wood may be very similar to those of *Gerardia*, but wood will not exhibit the finely dimpled surface texture that is characteristic of *Gerardia*. A hot-point test will produce the smell of burning wood.

- Specimens of *Primnoa* (Alaskan gold coral) exhibit growth rings like those of *Gerardia*, and have a similar texture and consistency. However, those of *Primnoa* will exhibit characteristic parallel longitudinal surface ridges or parallel lines in the material (**FIGURE 3.1.6**, AND SEE SECTION 3.1 ALASKAN GOLD CORAL).

- Dry, unpolished specimens of Antipatharia (black coral) may appear superficially similar to those of unpolished *Gerardia*—exhibiting similar growth rings, texture and consistency. However, Antipatharia does not naturally display the golden colour of *Gerardia* and the surface of Antipatharia is characterized by the presence of small spines, which are not present on the skeletons of *Gerardia* (SEE SECTION 3.3 BLACK CORAL AND **FIGURE 3.1.6**).

    - Specimens of “golden coral” (pieces of Antipatharia that have been turned gold in colour through immersion in hydrogen peroxide) may be distinguished from those of *Gerardia* primarily by surface texture: “golden coral” typically shows the remnants of the spines characteristic to Antipatharia (SEE SECTION 3.3 BLACK CORAL). In addition, pieces of “golden coral” tend to be glossier than pieces of *Gerardia* **(FIGURE 3.3.23)**.

3.6

RED AND PINK CORAL

Coralliidae

3.6 Red and Pink Coral
Coralliidae Lamouroux,1812

(A)

(B)

FIGURE 3.6.1 (A–B) dried red coral (*Corallium rubrum*) colonies showing the characteristic fan-like or bush-like shapes typical of the Coralliidae.Photograph A © Georgios Tsounis.

Other Common Names

ENGLISH Angel skin coral; Midway coral; Midway deep-sea coral; noble coral; pink coral; red coral; red coral of commerce; Sardinia coral

FRENCH Coraux rouges; rose corail

JAPANESE Aka sango (*C. japonicum*); bokè (*C. elatius*); momoiro sango (*C. elatius*); shiro sango (*C. konojoi*); sin kai sango (*Corallium* sp. nov.); middo sango (*C. secundum*)

SPANISH Coral rojo; coral rosa; coral Cerdeña

ITALIAN Bianco (*C. konojoi*); cerasuolo (*C. elatius*); garnet (*C.* sp. nov.); moro (*C. japonicum*); pelle d'angelo (*C. secundum*); rosato (*C. secundum*); Sardegna (*C. rubrum*); Sciacca (*C. rubrum*)[6]

Taxonomy

There are currently two genera (*Corallium* and *Paracorallium*) and 31 recognized species in the family Coralliidae in addition to a number of undescribed species and one listed as *Corallium* sp. nov. (Midway deep coral) (Anon., 2009; Grigg, 1993). The classification of the family, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
- SUBCLASS Alcyonaria (=Octocorallia)
  - ORDER Alcyonacea Lamouroux, 1816
    - SUBORDER Scleraxonia Studer, 1887
      - FAMILY Coralliidae Lamouroux, 1812

Box 3.6 Note Regarding Coralliidae

As of 2011, four species in the family Coralliidae had been listed by China on Appendix III of CITES. As a result, the Parties to the Convention were required to enforce the necessary CITES permitting requirements for those species. This in turn required enforcement and other authorities to identify products in trade made from Coralliidae to the species level in order to distinguish items made from the CITES-listed species from those not listed by CITES. Unfortunately, identifying worked pieces of Coralliidae to species is extremely difficult and may not be possible without use of laboratory techniques such as DNA analysis. Nonaka and Muzik (2009) note that some identifications reported in the scientific literature and identifications by commercial sources are doubtful. In some cases (e.g. when dealing with white or very pale specimens), even visual identification of worked coral and manufactured goods as being from the family Coralliidae is very difficult.

[6]Italian and Japanese common names have been included as they are sometimes used as trade names in other languages.

Synonyms

Synonyms for species of *Corallium* and *Paracorallium*, sourced from Anon. (2009), Appeltans *et al.* (2010), Bayer and Cairns (2003) and FAO (2010) are summarized in **TABLE 3.6.1**.

TABLE 3.6.1 SYNONYMS FOR SPECIES OF *CORALLIUM* AND *PARACORALLIUM*

Current Name	Synonyms
Corallium johnsoni Gray, 1860	*Hemicorallium* Gray, 1867
Corallium laauense Bayer, 1956	*Corallium regale* Baco and Shank, 2005 *Corallium laanense* Bayer and Cairns, 2003
Corallium rubrum (Linnaeus, 1758)	*Corallium rubrum* Lamarck, 1816 *Gorgonia nobilis* Linnaeus, 1789 *Isis nobilis* Pallas, 1766 *Madrepora rubra* Linnaeus, 1758
Corallium secundum Dana, 1846	*Pleurocorallium* Gray, 1867
Paracorallium inutile (Kishinouye, 1903)	*Corallium inutile* Kishinouye, 1903
Paracorallium japonicum (Kishinouye, 1903)	*Corallium japonicum* Kishinouye, 1903
Paracorallium salomonense (Thomson & Mackinnon, 1910)	*Corallium salomonense* Thomson & Mackinnon, 1910
Paracorallium stylasteroides (Ridley, 1882)	*Corallium stylasteroides* Ridley, 1882
Paracorallium tortuosum (Bayer, 1956)	*Corallium tortuosum* Bayer, 1956
Paracorallium thrinax (Bayer and Stefani, 1996)	*Corallium thrinax* Bayer and Stefani, 1996
Paracorallium nix (Bayer, 1996)	*Corallium nix* Bayer, 1996

Distribution

- Species of Coralliidae are distributed throughout the world's oceans, including the Atlantic, eastern Pacific, western Pacific and Indian Oceans; and the Mediterranean Sea. They are found at depths ranging from seven to 1,500 metres (Anon., 2009).

- According to Anon. (2009), the only known populations of Coralliidae large enough to support commercial harvest are found north of 19 degrees North latitude.

- The distribution of the most commercially important species of Coralliidae is shown in **TABLE 3.6.2**.

TABLE 3.6.2 DISTRIBUTION AND COLOUR OF COMMERCIALLY IMPORTANT CORALLIIDAE

Species	Common name	Distribution	Colour
Corallium elatius	Pink coral, momoiro sango, momo	Japan to the northern Philippines; Indonesia and Viet Nam	Light red, salmon, orange, and pink colors; interior core of white
Corallium konojoi	White coral, siro sango	Japan to the northern Philippines; and Viet Nam	White; white with red or pink spotting
Corallium regale	Pink coral	Hawaii to the Milwaukee Banks in the Emperor Seamounts	Pink; may be streaked with white
Corallium rubrum	[Mediterranean] red coral, chichuukai sango, kowatari sango	Mediterranean Sea including the coasts of Sardinia, Corsica, southern Italy, Sicily, northern Tunisia, France and Spain; and north temperate eastern Atlantic	Solid red; pale pink or white is rare
	Sciacca	Sicily (near town of Sciacca); fossil or near-fossil	Salmon or orange-pink (bright or pale), occasionally yellowish marks
Corallium secundum	Midway coral, pink coral, angel skin, bokè, mittdo sango	Hawaii to the Milwaukee Banks in the Emperor Seamounts	White, spotted pink, light pink
Corallium sp. nov.	Midway deep-sea coral, sinkai sango	Midway Island to Emperor Seamounts	Bright pink with strong red markings (never a solid colour)
Paracorallium japonicum	Red coral, aka sango, tiaka	Okinawa and Bonin Islands of Japan	Dark to very dark red, blood red; interior core of white

Sources: Iwasaki (2010); Anon. (2009); Grigg (1984); Liverino (1989); Torntore (2002); Tsounis *et al.* (2010); Cicogna and Cattaneo-Vietti (1993); S. Kosuge, Institute of Malacology of Tokyo, *in litt.* to E. Cooper, Feb. 12, 2011; K. Muzik, Scientific Consultant, *in litt.* to E. Cooper, Feb. 12, 2011.

Multinational Conservation Status

- In 1992, *C. rubrum* was listed on Annex V of the European Union Habitats Directive (*Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*) (Anon., 1992).

- On July 1, 2008, *C. elatius, C. japonicum, C. konojoi, and C. secundum* were listed by China on Appendix III of CITES (UNEP-WCMC, 2010).

- As of 2010, no species of Coralliidae had been assessed in the IUCN Red List of Threatened Species.

- As of 2010, the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) listed *C. rubrum* on Appendix III (Protected Fauna Species) (Council of Europe, 1997).

- As of 2010, *C. japonicum, C. konojoi, C. elatius, and C. secundum* were listed in Annex C of the EC Wildlife Trade Regulations (*Commission Regulation (EU) No 709/2010 on amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein*) (Anon., 2010).

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Alcyonacea (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of Coralliidae in waters outside of their respective exclusive economic zones.

Characteristics

- Colonies of Coralliidae are branched and fan-like or bush-shaped, giving them the appearance of small trees (**FIGURES 3.6.1–3.6.9**). Colonies may reach a size of 50 centimetres across (Anon., 2009; Pedersen, 2004; Dridi, 2009). Nonaka and Muzik (2009) note that the branching pattern of a colony is often an important characteristic for identifying octocorals [Subclass Alcyonaria].

- The Coralliidae have a solid axial skeleton that is made primarily of calcium carbonate (85 percent of the wet weight) in the form of calcite, plus a small amount of other elements in an organic matrix (Anon., 2009; Allemand and Bénazet-Tambutté, 1996; Dridi, 2009; Pedersen, 2004).

- Dead specimens of Coralliidae may be coated with the remains of the living tissues **(FIGURES 3.6.2 –3.6.6)** but will be cleaned before being worked. According to Pedersen (2004) and Torntore (2002), the coral is typically bleached before being worked.

- Skeletons of Coralliidae display very fine parallel surface ridges that extend longitudinally along the branches, spaced between 0.25 and 0.5 millimetres apart (**FIGURES 3.6.6–3.6.10**). Once the coral is polished, traces of the ridges may be observed as faint longitudinal lines in the material **(FIGURE 3.6.11)**. Typically these lines may be readily seen on red-coloured specimens. However, they can be very difficult to see on white or pale pink specimens (Pedersen, 2004). The lack of visible lines can make it very difficult (if not impossible) to conclusively identify worked pieces of light-coloured species (e.g. *C. elatius* or *C. konojoi*) as being specimens of Coralliidae **(FIGURE 3.6.12)**.

- In cross-section and under low magnification, the longitudinal lines visible in polished pieces of Coralliidae will appear as radiating lines around a central white area (Pedersen, 2004; O'Donoghue, 2006; Smith *et al.,* 2007).

Characteristics (continued)

- Skeletons of Coralliidae may be pure white, but typically range in colour from shades of pink, salmon and orange to blood red (Anon., 2009) **(FIGURES 3.6.7–3.6.12)**. The colour may be solid or streaked **(FIGURE 3.6.9)**. The bright colours exhibited by skeletons of Coralliidae are due to the presence of carotenoid pigments (Dridi, 2009). Colour alone is not a reliable or consistent characteristic for identifying specimens of Coralliidae to the species level. Nonaka and Muzik (2009) offer examples of cases where reliance on colour has sometimes led to taxonomic misidentifications.

- The quality (and value) of a product made from Coralliidae can vary depending on whether the specimen utilized was harvested as a living or dead colony (or a dead broken branch) **(FIGURES 3.6.13–3.6.15)**. In Japan coral specimens with a deep colour and high translucency are considered to be of higher value. The colour and translucency of a specimen is affected as a dead coral ages on the ocean bottom. Therefore, coral that was harvested live is the most valuable (Iwasaki, 2010). The Japanese classification of colonies of Coralliidae harvested alive or dead, from Iwasaki (2010) and S. Kosuge, Institute of Malacology of Tokyo, *in litt*. to E. Cooper, July 15, 2011, is as follows **(FIGURE 3.6.16)**:

    1. Seiki: coral harvested live and having the highest value.

    2. Ichi-kare (gare): dead coral showing minimal deterioration, harvested while still attached to rocks and having a lower value than seiki.

    3. Ni-kare (gare): coral that has died and has fallen to the ocean floor. This coral is yellowish in colour, has lost its translucency and has a lower value than ichi-kare.

    4. San-kare (gare): coral that has died and has fallen to the ocean floor and has more advanced deterioration. These specimens have the lowest value (and may have no value).

Characteristics (continued)

- Fossil or sub-fossil Coralliidae, called Sciacca, has been extensively harvested in the Mediterranean (Cicogna and Cattaneo-Vietti, 1993; Tsounis *et al*., 2010). Sciacca coral refers to *C. rubrum* specimens collected from three beds discovered in the nineteenth century near the Italian village of Sciacca in the Mediterranean. These beds consisted of long stretches of muddy seabed where thick deposits of coral had built up and been covered with mud (which helped to protect the coral from boring sponges) (Cicogna and Cattaneo-Vietti, 1993; Liverino, 1989)[7]. The colony structure of Sciacca coral is straight and long, without many branches, and it is a soft salmon or pinkish-orange colour rather than the bright red colour typical of *C. rubrum* (Torntore, 2002) **(FIGURE 3.6.17)**. Sciacca recovered from the upper layers was much better quality than that from the lower layers (Cicogna and Cattaneo-Vietti, 1993; Liverino, 1989). Sciacca currently found is blackened and damaged and of poor colour (Liverino, 1989). See also section 3.8.2 Fossil Coral for definitions of fossil as it applies to coral.

- Fossil Coralliidae is also reportedly collected in the Himalayas. This material, called red mountain coral, is apparently extremely rare, expensive and highly desirable to collectors (Dorian Rae, pers. comm. to E. Cooper, July 3, 2011).

- The quality of products made from Coralliidae is also affected by damage from boring sponges of the family Clionidae. Boring sponges create a series of interconnected holes in a coral skeleton, resulting in a spongy appearance (Cattaneo-Vietti and Bavestrello, 2010) **(FIGURES 3.6.13** and **3.6.18)**.

- Products made from Coralliidae take a high polish and feel cool to the touch [as do other materials composed of calcium carbonate] (Pedersen, 2004).

- A hot-point test on specimens of Coralliidae will produce no significant result.

---

[7]These beds produced enormous amounts of coral: over an area of 2.5 miles, a layer of coral 20 metres thick was removed over a period of 34 years (Liverino, 1989).

(A)

(B)

(C)

FIGURE 3.6.2 (A–B) pieces of dried pink coral (*Corallium laauense*) colonies that are still covered with dried tissue; **(C)** a close-up view of the cut ends of specimens **(B)** showing the bright pink colour of the skeleton.

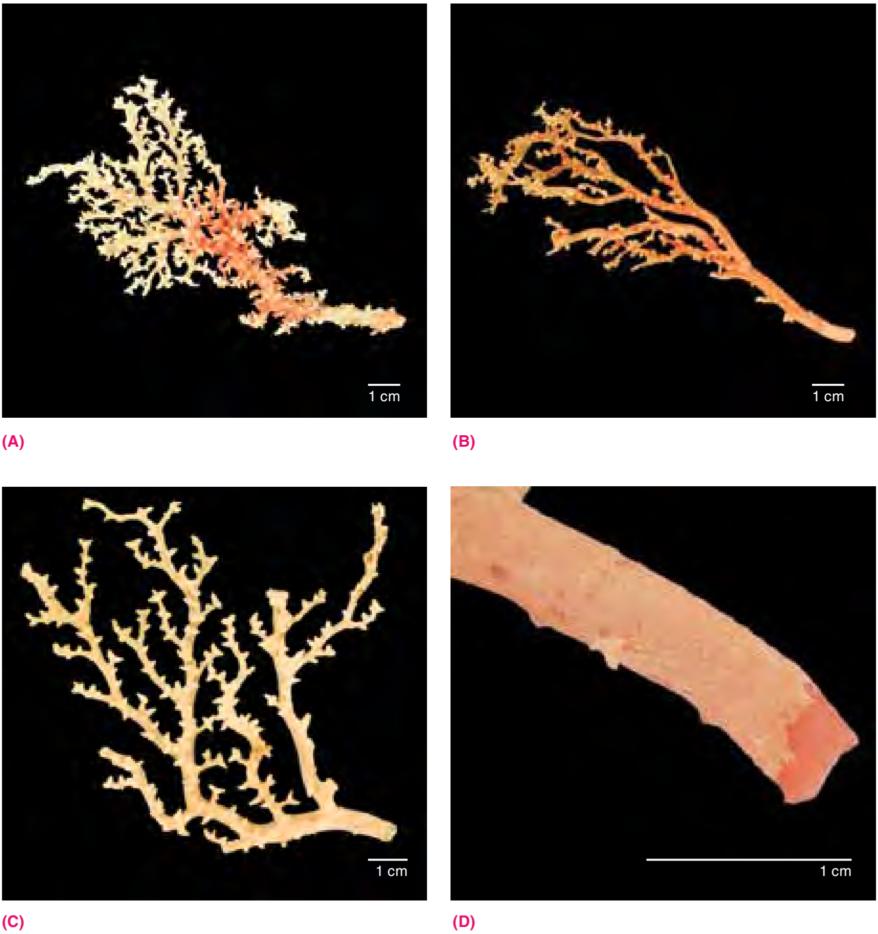


FIGURE 3.6.3 (A–C) pieces of dried pink coral (*Corallium regale*) colonies that are still covered with dried tissue; **(D)** a close-up view of specimen **(C)**.

(A)

(B)

(C)

FIGURE 3.6.4 (A–B) small dried red coral (*Corallium rubrum*) colonies that are still covered with dried tissue; **(C)** a close-up view of specimen **(B)**.

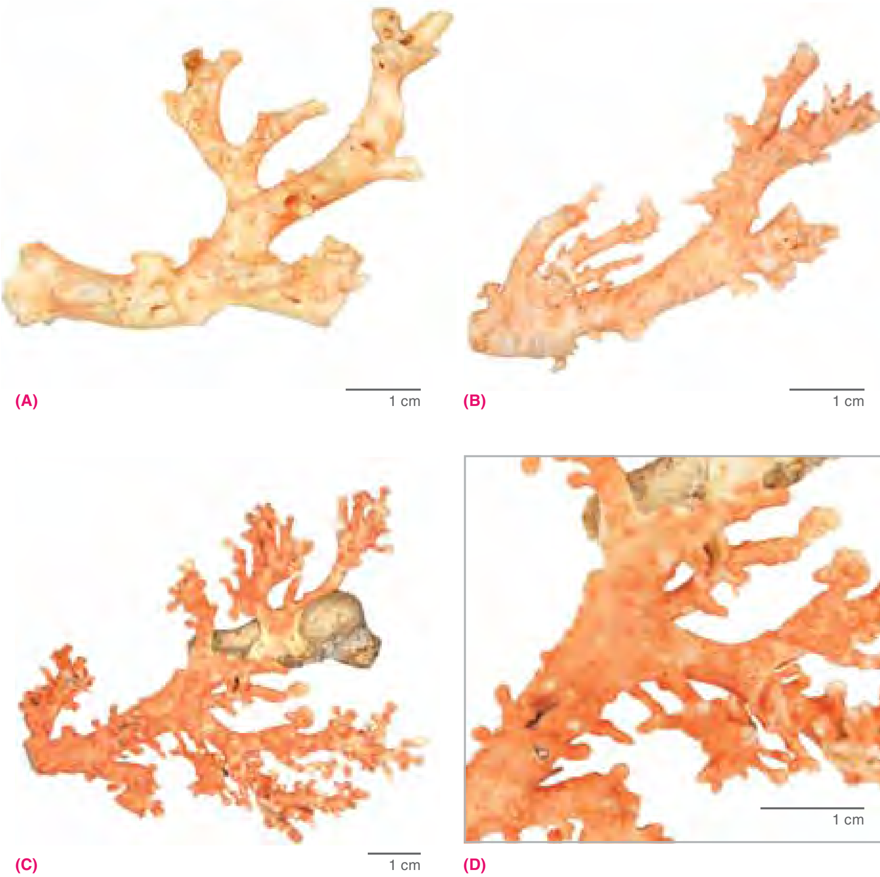


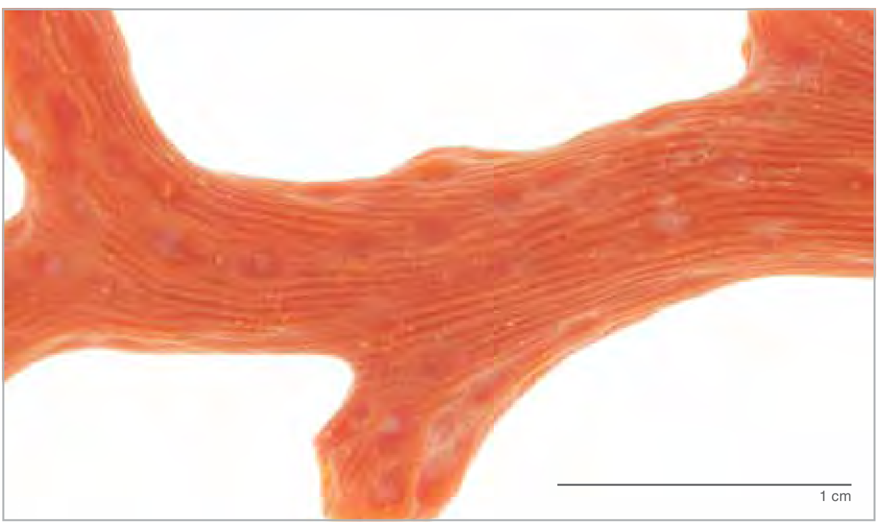
FIGURE 3.6.5 (A– C) pieces of dried pink coral (*Corallium secundum*) colonies that are still covered with dried tissue; **(D)** a close-up view of specimen **(C)**.

(A)

(B)

FIGURE 3.6.6 (A) a small dried red coral (*Paracorallium japonicum*) colony that is partially covered with dried tissue; **(B)** a close-up view showing the fine parallel, longitudinal surface ridges.

(A)



(B)

FIGURE 3.6.7 (A) a small dried red coral (*Corallium rubrum*) colony that has been cleaned of tissue to reveal the fine parallel surface ridges that extend longitudinally along the branches; **(B)** a close-up view.

(A)

(B)

FIGURE 3.6.8 (A) a piece of cleaned, dried pink coral (*Corallium elatius*) skeleton; **(B)** a close-up view. The characteristic fine parallel, longitudinal surface ridges are very faint, but visible under magnification.

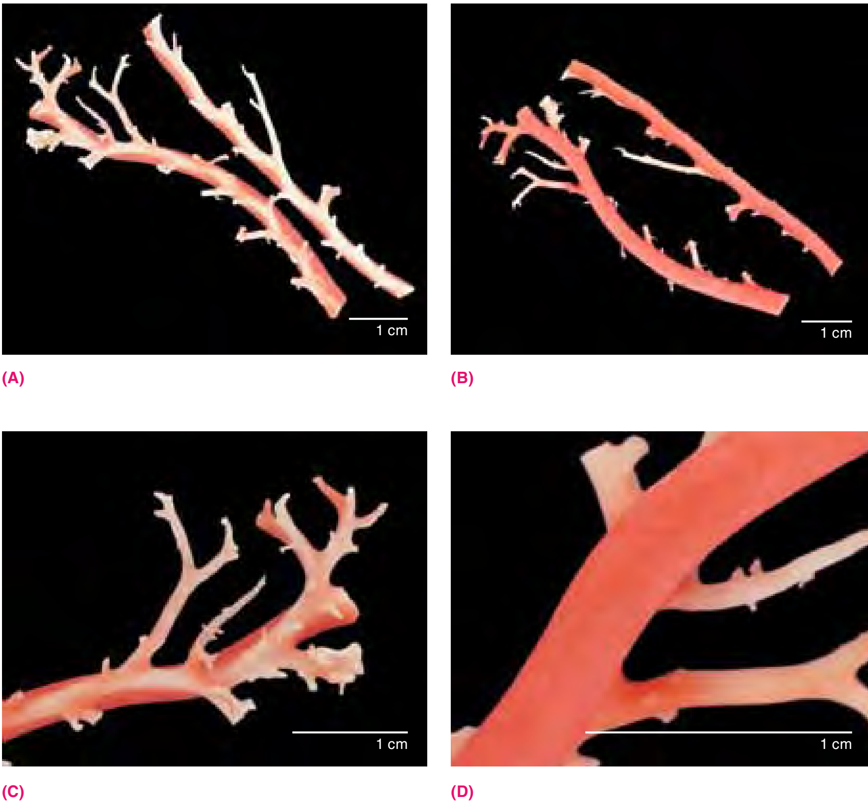
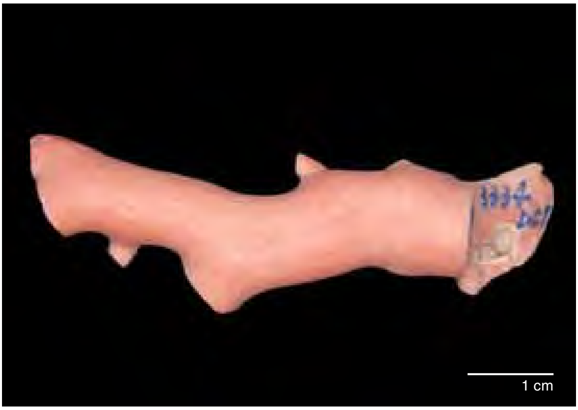
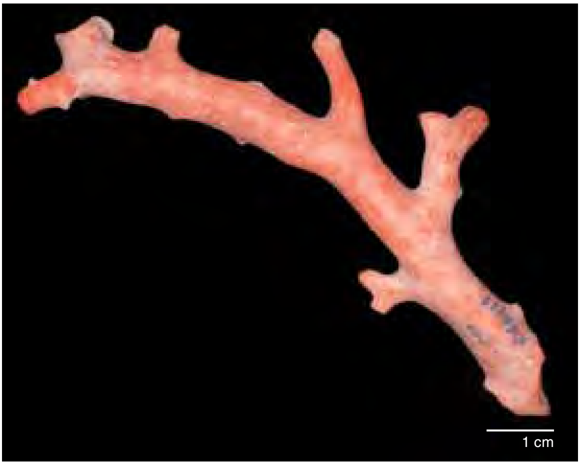


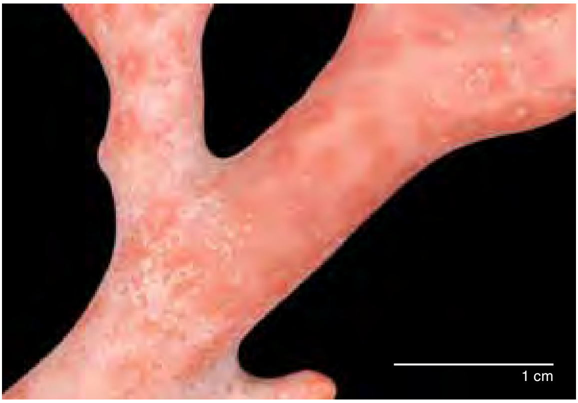
FIGURE 3.6.9 (A – B) front and back views of two pieces of cleaned, dried pink coral (*Corallium regale*) skeletons; **(C)** a close-up view showing the streaked colouration; **(D)** a close-up view showing the fine parallel, longitudinal surface ridges.



(A)



(B)



(C)

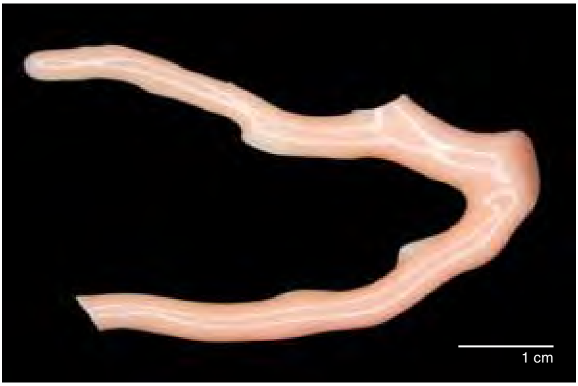
FIGURE 3.6.10 (A – B) pieces of cleaned, dried pink coral (tentatively identified as *Corallium* sp. nov.) skeletons; **(C)** a close-up view of specimen **(B)** showing the spotted colouration and fine parallel, longitudinal surface ridges.

(A)

(B)

FIGURE 3.6.11 (A) a polished piece of red coral *(Corallium* sp.) skeleton; **(B)** a close-up view showing the fine parallel, longitudinal lines that are characteristic of polished specimens.

(A)



(B)

(C)

FIGURE 3.6.12 (A–B) polished pieces of pink coral *(Corallium elatius*) skeleton; **(C)** a close-up view of specimen **(B)**. The characteristic fine parallel, longitudinal lines are very faint, but visible under low magnification. Note the significant difference in colour between these specimens of *C. elatius* and the piece shown in FIGURE 3.6.8.

FIGURE 3.6.13 pieces of pink coral (*Corallium sp.*) from a skeleton that was collected as a dead specimen. Note the holes created by boring sponges.

(A)

(B)

(C)

FIGURE 3.6.14 (A–C) pieces of pink coral (*Corallium secundum*) that were collected as dead specimens.

FIGURE 3.6.15 (A–C) pieces of pink coral (*Corallium sp.*) that were collected as dead specimens; **(D)** a close-up view of the cut end of specimen **(C)** showing that the core of the specimen is still solid and coloured.

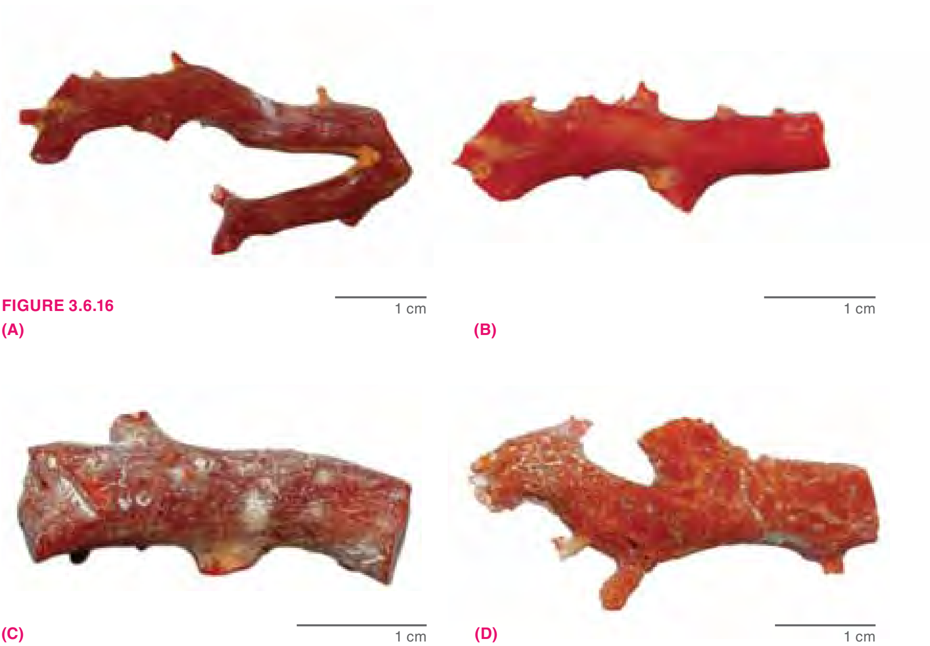


FIGURE 3.6.16

FIGURE 3.6.17

FIGURE 3.6.16 a comparison of red coral (*Paracorallium japonicum*) specimens graded following the Japanese system of classification: **(A)** harvested live (seiki); **(B)** harvested dead with minimal deterioration (ichi-kare); **(C)** harvested dead after falling to the ocean floor (ni-kare); **(D)** harvested dead with advanced deterioration (san-kare).

FIGURE 3.6.17 pieces of Sciacca coral (*Corallium rubrum*).

FIGURE 3.6.18 (A–B) two views of a bead made from pink coral (*Corallium elatius*) skeleton that had been damaged by boring sponges.

Trade

- According to Anon. (2009), six species of Coralliidae (*C. elatius*, *C. konojoi*, *C. rubrum*, *C. secundum*, *Corallium* sp. nov. and *P. japonicum*) are the most commercially valuable and make up the bulk of landings. In addition, a limited harvest of *C. regale* occurred in 1999–2000 (Grigg, 2002)[8]. These species therefore will be those most likely encountered in international trade **(TABLE 3.6.2)**.

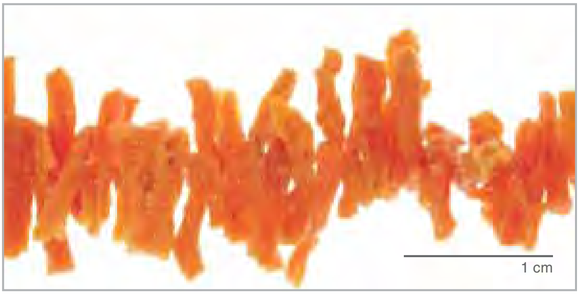
- Species of Coralliidae are traded as whole, dried colonies and unworked branches and branch fragments **(FIGURES 3.6.1–3.6.17)** as well as beads **(FIGURES 3.6.18–3.6.22)** and manufactured jewellery **(FIGURES 3.6.23–3.6.34)**.

- Larger colonies may be carved into statues and figurines **(FIGURES 3.6.35–3.6.37)**. However, these products have become less common in trade as fishing has reduced the available number of larger colonies of Coralliidae (Torntore, 2002).

[8]Some sources have suggested that *Corallium laauense* and *C. regale* are synonymous. However, Bayer (1956) clearly described these as separate species. Sources have also suggested that *C. laauense* has been harvested for trade in Hawaii, but *C. laauense* is extremely rare and all of the red coral that has been harvested in Hawaii has been *C. regale* (R. Grigg, University of Hawaii, *in litt*. to E. Cooper, February. 9, 2011).

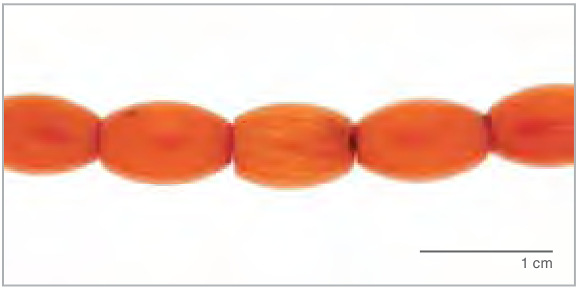
(A)

(B)



(C)

FIGURE 3.6.19 (A–C) close-up views of organically-shaped beads made from small pieces of red coral (*Corallium rubrum*) skeletons.



(A)

(B)

(C)

(D)

FIGURE 3.6.20 close-up views of small beads of different shapes made from red coral skeletons: **(A)** *Corallium elatius;* **(B–D)** *Corallium rubrum*. Note that the characteristic fine parallel, longitudinal lines can often be seen even on very small beads.

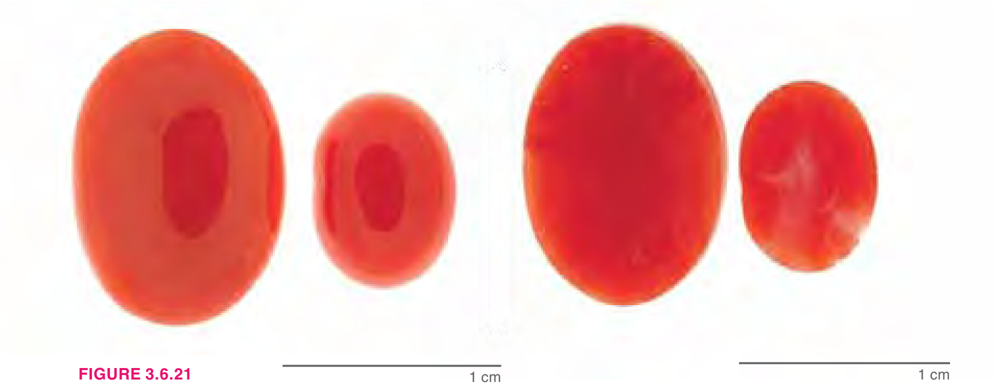


FIGURE 3.6.21
(A) (B)

FIGURE 3.6.22
(A)

(B)

FIGURE 3.6.21 close-up views of small cabochons made from red coral (*Paracorallium japonicum*) skeleton: **(A)** top (rounded); **(B)** bottom (flat).

FIGURE 3.6.22 (A–B) close-up views of cylindrical beads made from pink coral (*Corallium elatius*) skeletons.

FIGURE 3.6.23
(A)

(B)

FIGURE 3.6.24

FIGURE 3.6.23 (A) Tibetan prayer beads that are inset with small pieces of red coral (*Corallium* sp.) skeletons; **(B)** close-up view.

FIGURE 3.6.24 A Navajo bracelet made using pieces of red coral (*Corallium rubrum*) skeleton inset in silver. From the Antonino De Simone collection.

FIGURE 3.6.25
(A)

(B)

FIGURE 3.6.26
(A)

(B)

FIGURE 3.6.25 (A) a Navajo bracelet by Vivian Barbone (circa 1990s) made using pieces of red coral (*Corallium rubrum*) skeleton inset in silver; **(B)** a close-up view.

FIGURE 3.6.26 (A) a Navajo bracelet by Clarence Chama (circa 1960) made using pieces of red coral (*Corallium* sp.) skeleton inset in silver; **(B)** a close-up view. From the Dorian Rae collection.

(A)

(B)

(C)

(D)

FIGURE 3.6.27 (A–D) pendants made using pieces of pink and red coral (*Corallium* sp.) skeletons.

(A)

(B)

FIGURE 3.6.28

FIGURE 3.6.29

FIGURE 3.6.28 (A–B) brooches made using pieces of red coral (*Corallium rubrum*) skeletons. The item shown in **(B)** is from the Antonino De Simone collection.

FIGURE 3.6.29 A necklace made from two different colours (and possibly species) of pink coral (*Corallium sp.*) skeletons.

(A)

(B)

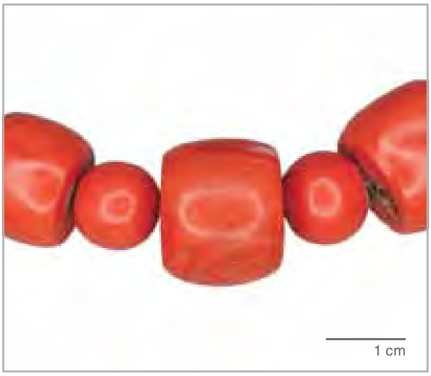
FIGURE 3.6.30 (A) a necklace made from pieces of white coral (*Corallium konojoi*) skeleton; **(B)** a close-up view. From the Dorian Rae collection.

(A)

(B)

FIGURE 3.6.31 (A) an antique Mongolian lock necklace from the 18th century (or earlier) made with pieces of red coral (*Corallium* sp.) skeleton; **(B)** a close-up view. From the Dorian Rae collection.

FIGURE 3.6.32
(A)



(B)

FIGURE 3.6.33
(A)

(B)

FIGURE 3.6.32 (A) an antique Tibetan necklace created from spherical and barrel-shaped red beads made from red coral (*Corallium* sp.) skeleton; **(B)** a close-up view. From the Dorian Rae collection.

FIGURE 3.6.33 (A) Tibetan earrings made with pieces of red coral (*Corallium* sp.) skeleton; **(B)** a close-up view. From the Dorian Rae collection.

(A)

(B)

FIGURE 3.6.34 (A) a necklace made from "red mountain coral" (reportedly fossil Coralliidae from the Himalayas) and gold beads; **(B)** a close-up view. From the Dorian Rae collection.

FIGURE 3.6.35

FIGURE 3.6.36
(A)

(B)

(C)

FIGURE 3.6.35 A freshly completed (and unpolished) carving made from red coral (*Corallium* sp.) skeleton.

FIGURE 3.6.36 (A–C) examples of carved red coral (*Corallium* sp.) skeleton. From the Antonino De Simone collection.

FIGURE 3.6.37

FIGURE 3.6.37 A cameo carved from pink coral (*Corallium* sp.) skeleton. From the Antonino De Simone collection.

Similar Products

- Plastic items **(FIGURES 3.6.38–3.6.39)** may exhibit the same colour and glossiness as pieces of Coralliidae. However, plastic is not cool to the touch; lacks the characteristic fine longitudinal lines seen in the skeletons of Coralliidae; and is readily scratched or damaged whereas products made from Coralliidae are very hard (Pedersen, 2004). A hot-point test on plastic will produce the smell of burning plastic or sour milk (a hot-point test on a specimen of Coralliidae will produce no significant result). See also sections 3.2 Bamboo Coral and 3.2.1 Jointed Coral.

- Glass beads may be similar in appearance to pieces of Coralliidae as they are smooth, hard and cool to the touch, but may be distinguished by the lack of longitudinal lines. In addition, glass beads may contain air bubbles and other flaws (Pedersen, 2004) **(FIGURE 3.6.40)**. See also sections 3.2 Bamboo Coral and 3.2.1 Jointed Coral.

- Bamboo corals (family Isididae) have a parallel longitudinal ridge pattern that is similar to the ridges seen in the skeletons of Coralliidae. However, the ridges on bamboo corals that are common in trade are much coarser—being approximately 1 mm apart (Pedersen, 2004). Bamboo coral are also naturally off-white in colour and are typically dyed different colours **(FIGURES 3.6.41–3.6.42)** (SEE SECTIONS 3.2 BAMBOO CORAL and 3.2.1 JOINTED CORAL). Dyes can usually be removed by applying acetone or nail polish remover to the specimen.

Similar Products (Continued)

- Products made from Melithaeidae (sponge coral) could be mistaken for (and may be marketed as) items made from Coralliidae due to their natural red colour. However, products made from Melithaeidae may be readily identified by their sponge-like texture and vein-like banding which are not exhibited on specimens of Coralliidae. In some cases skeletons of Coralliidae that have been damaged by boring sponges may have areas of spongy appearance, but the spongy texture will not be consistent through the entire specimen and there will be no vein-like banding (SEE SECTION 3.7 SPONGE CORAL).

- Shell products may be mistaken for pieces of Coralliidae as they have similar density and composition, and often have layers that may be interpreted as the longitudinal lines seen in products made from Coralliidae. However, shell layers are much thicker than the lines characteristic of Coralliidae and are composed of alternating light and dark material that, in cross-section, do not meet at a single focal point in the way that the lines of Coralliidae do. See also section 3.2 Bamboo Coral.

FIGURE 3.6.38 (A)

(B)

FIGURE 3.6.39

FIGURE 3.6.38 (A) a 1920s brooch made from Bakelite (plastic) which could be a possible imitation of red coral; **(B)** a close-up view.

FIGURE 3.6.39 A plastic imitation red coral pendant.

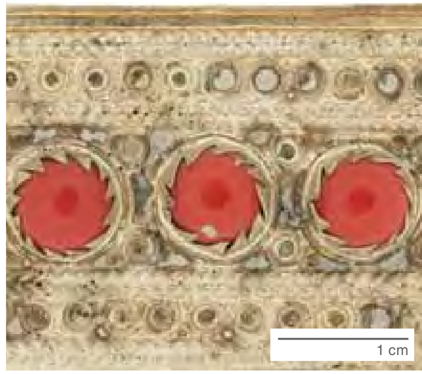
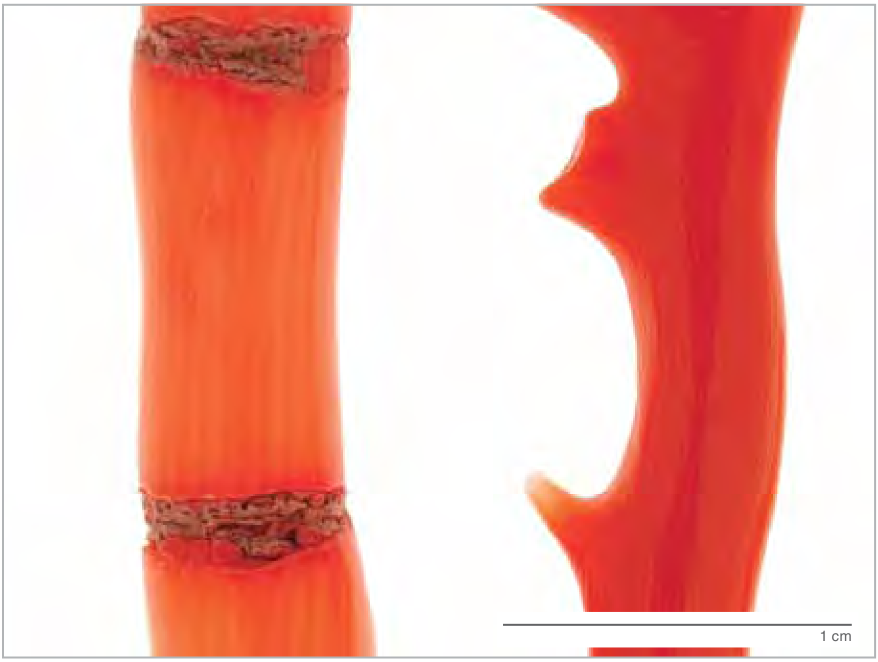


FIGURE 3.6.40
(A) **(B)**

FIGURE 3.6.41
(A) **(B)**

FIGURE 3.6.40 (A) a necklace (from India) made from metal and red glass beads; **(B)** a close-up view.

FIGURE 3.6.41 A comparison of close-up views of clean, unpolished skeletons of **(A)** bamboo coral (*Isis hippuris*); **(B)** red coral (*Corallium* sp.).



(A) (B)

FIGURE 3.6.42 A comparison of close-up views of clean, polished skeletons of **(A)** bamboo coral (*Isis hippuris*); **(B)** red coral (*Corallium* sp.).

3.7

SPONGE CORAL

Melithaeidae

3.7 Sponge Coral
Melithaeidae Gray, 1870

FIGURE 3.7.1 A whole, dried sponge coral skeleton.

Other Common Names

ENGLISH	Apple coral; grass coral; jointed coral; knotted fan coral; limestone coral; red coral; red king coral; red soft coral; root coral; rose coral
FRENCH	Corail d'éponge; corail tigre
JAPANESE	Supongi sango
SPANISH	Coral esponja

Taxonomy

There are six genera and approximately 101 described species in the family Melithaeidae. The classification of the family, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Alcyonaria (=Octocorallia)
ORDER Alcyonacea Lamouroux, 1816
SUBORDER Scleraxonia Studer, 1887
FAMILY Melithaeidae Gray, 1870

Distribution

- Colonies of Melithaeidae occur exclusively in shallow water regions of the Indo-Pacific (Grasshoff and Bargibant, 2001). Specimens may be found growing on harbour structures, boulders, on reefs in between stony corals (Scleractinia) and on slopes down to a moderate depth (Grasshoff and Bargibant, 2001).

Box 3.7 Note Regarding Melithaeidae

Many sources (e.g. books, Internet websites, etc.) identify the species of sponge coral in international trade as being *Melithaea ochracea*. However, all but one of the genera (*Asperaxis*) in the family Melithaeidae have the same basic structure, and it is extremely difficult, if even possible, to identify the species or even genus from just the skeleton. It is therefore not possible to identify which genera or species of Melithaeidae are being utilized and traded internationally as beads and jewellery. It is virtually certain that a number of different genera and species are being utilized (P. Alderslade, Octocoral taxonomist and Fellow, CSIRO Marine and Atmospheric Research, *in litt.* to E. Cooper, Oct. 6, 2010).

Multinational Conservation Status

- As of 2010, no species of Melithaeidae had been assessed in the IUCN Red List of Threatened Species or listed in the Appendices of CITES, and there was no international regulation of trade in Melithaeidae.

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Alcyonacea (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of Melithaeidae in waters outside of their respective exclusive economic zones.

Characteristics

- Colonies of Melithaeidae may be bushy or broad and fan-like with branching usually starting at the gorgonin nodes (Fabricius and Alderslade, 2001) **(FIGURE 3.7.1)**. At least one species (*Melithaea ochracea*) can grow upwards of 1.5 metres high and one metre across (Grasshoff and Bargibant, 2001).

- Skeletons of Melithaeidae are segmented—consisting of alternating calcareous internodes and short nodes composed of gorgonin (Coffey, 1991; Grasshoff and Bargibant, 2001; Fabricius and Alderslade, 2001) **(FIGURE 3.7.2)**. Both the nodes and internodes are perforated by canals (Hickson, 1924) **(FIGURE 3.7.3)**.

- Both the internodes and nodes of Melithaeidae include microscopic short, smooth, rod-shaped sclerites that are inseparably cemented together in the calcareous internodes, and embedded yet separable in the gorgonin nodes (Fabricius and Alderslade, 2001; van Ofwegen *et al.*, 2000). The nodes are firm but flexible (Fabricius and Alderslade, 2001).

- The surface of a dried skeleton of Melithaeidae may retain remnants of brightly coloured tissue containing characteristic sclerites **(FIGURES 3.7.4 –3.7.5)**. These tissue remains are not present on cleaned pieces and products in trade.

- The dried skeleton of the thick basal regions of large colonies of Melithaeidae is porous and appears spongy and brittle, rather than solid—hence the common name of sponge coral—and its surface is matte, rough and abrasive rather than smooth (Pedersen, 2004). The open and irregularly porous structure is distinctive (Smith *et al.,* 2007) **(FIGURE 3.7.6)**.

Characteristics (Continued)

- In products made from Melithaeidae, the nodes form a distinctive pattern of vein-like bands that appear less porous than the bulk of the skeleton (the internodes) **(FIGURES 3.7.6–3.7.8)**. The nodes are typically light yellow or brown in colour whereas the internodal material is usually an orange-red colour, giving the product a variegated appearance (Pedersen, 2004). Products may be dyed a deeper red (Pedersen, 2004). "Tiger coral" is a trade name often used for products made from Melithaeidae in which the colours are reversed, consisting of dark bands running through lighter internodal material (**FIGURE 3.7.7)**.

- Beads and other products made from Melithaeidae are often impregnated with resins in order to stabilize and solidify the skeleton, and give the product a smooth surface (Pedersen, 2004; Smith *et al.,* 2007) **(FIGURES 3.7.11–3.7.13)**. Products impregnated with resin tend to have a sheen rather than a high polish (Pedersen, 2004).

- Hot-point tests on the internodes of Melithaeidae will produce no significant result, whereas hot-point tests on the nodes will produce a distinct burning smell. A hot-point test on a specimen that has been impregnated with resin will produce a sweet/plastic or chemical smell.

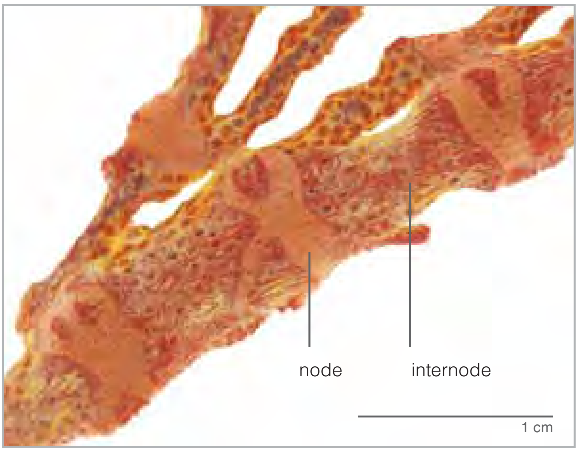


FIGURE 3.7.2

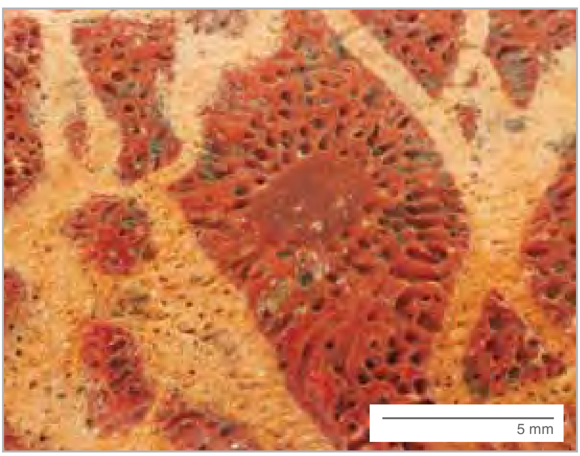


FIGURE 3.7.3

FIGURE 3.7.2 A piece of a dried colony of sponge coral that has been partially cleaned of tissue to reveal the underlying skeletal morphology.

FIGURE 3.7.3 A close-up view of a piece of sponge coral.

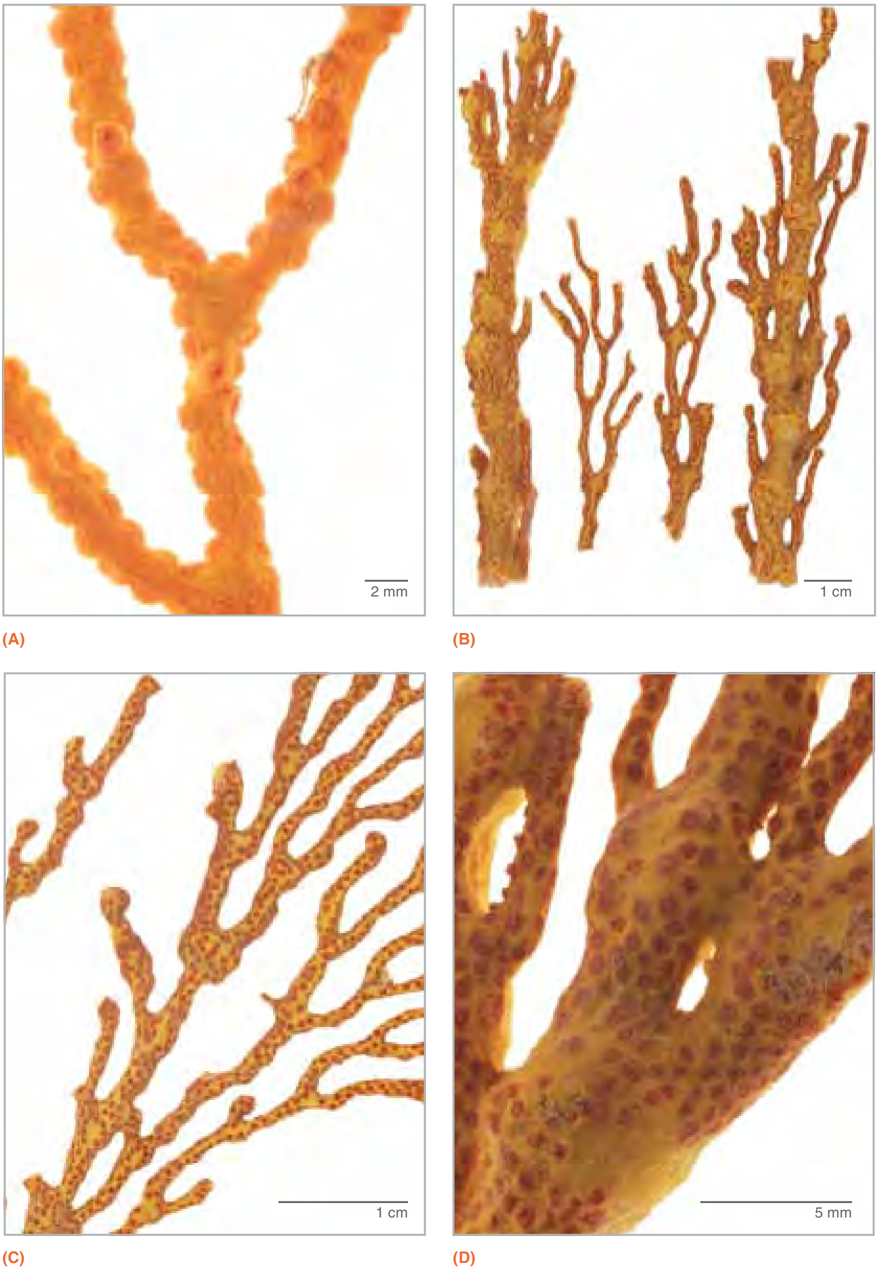
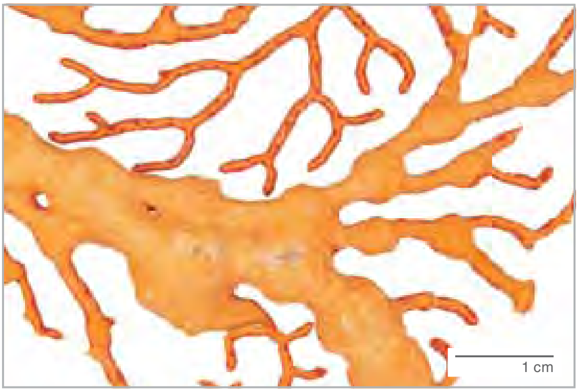
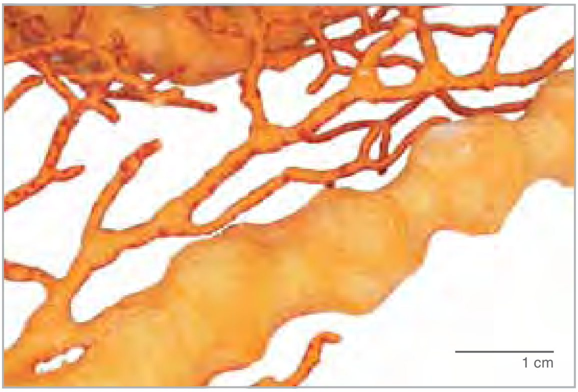


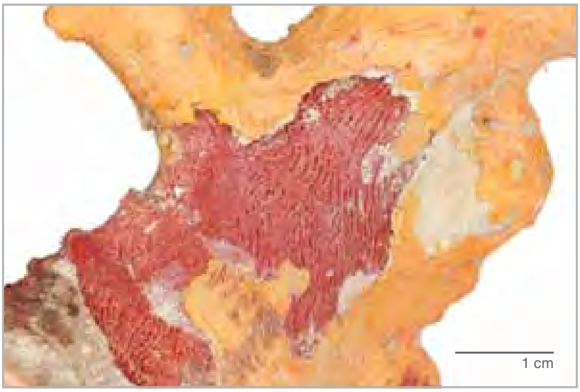
FIGURE 3.7.4 (A–D) Pieces of dried sponge coral skeletons which still retain tissue on their surfaces.



(A)



(B)



(C)

FIGURE 3.7.5 (A–C) Pieces of a dried colony of *Melithaea ochracea*.

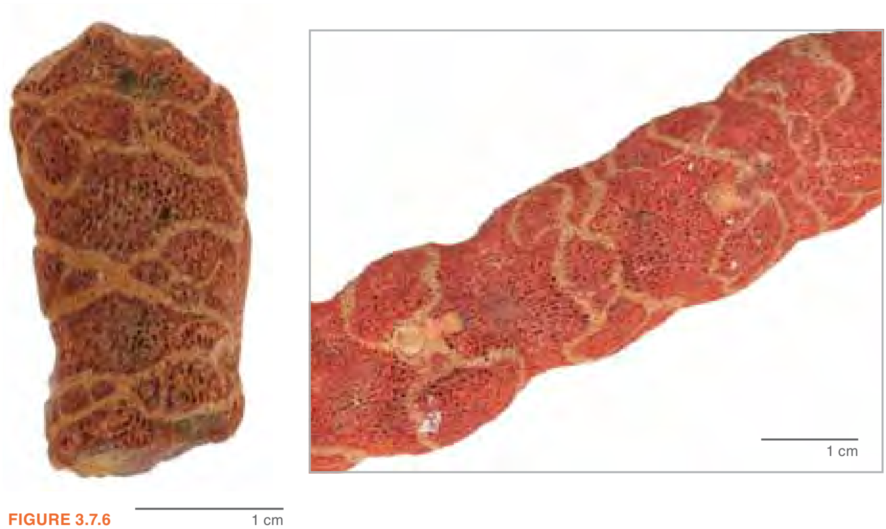


FIGURE 3.7.6
(A) **(B)**

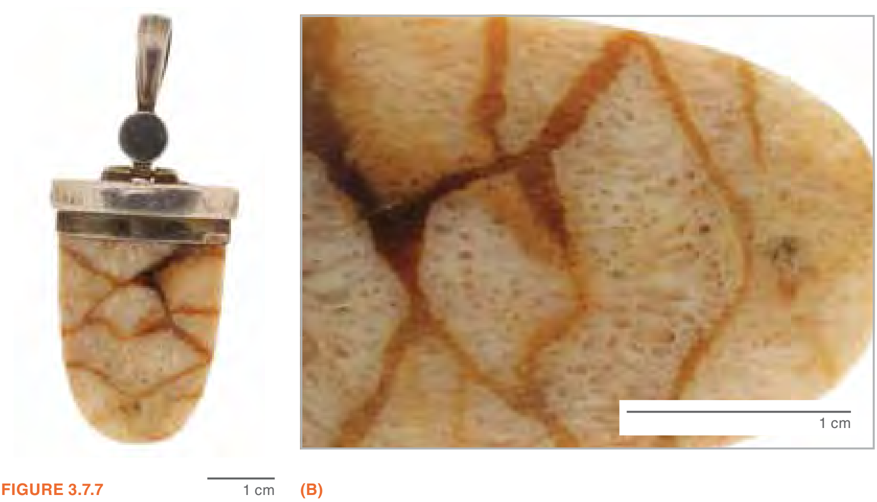


FIGURE 3.7.7
(A) **(B)**

FIGURE 3.7.6 (A– B) Dried, cleaned pieces of sponge coral skeleton.

FIGURE 3.7.7 (A) a pendant made from "Tiger coral"; and **(B)** a close-up view.

FIGURE 3.7.8

FIGURE 3.7.9

FIGURE 3.7.8 A longitudinal section of an organically-shaped bead made from a piece of unpolished sponge coral.

FIGURE 3.7.9 The base of a sponge coral colony.

FIGURE 3.7.10 Sponge coral beads: **(A)** disk-shaped; **(B)** spheres; **(C)** rectangular; and **(D)** organically-shaped.

(A)

(B)

FIGURE 3.7.11 Beads made from sponge coral: **(A)** uncoated; and **(B)** impregnated with resin. The impregnated beads have also had their colour enhanced.

FIGURE 3.7.12
(A) (B)

FIGURE 3.7.13

FIGURE 3.7.12 (A) a sponge coral bead that has been impregnated with resin and has had its colour enhanced; and **(B)** a cotton swab soaked in acetone-free nail polish remover that has been used to remove some of the resin and dye.

FIGURE 3.7.13 Beads made from sponge coral that have been shaped to resemble chilli peppers. These beads have been impregnated with resin and have had their colour enhanced. Note the drip of dried resin on the bead in the centre.

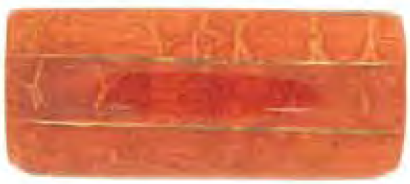
Trade

- The skeletons of Melithaeidae are used for the manufacture of jewellery. Small pieces of skeleton are found in trade in various forms, commonly as beads. They may be coated with resin or unpolished. Finished products include pendants, rings, bracelets, necklaces, etc. **(FIGURES 3.7.14–3.7.18)**. Small fragments of skeleton may be mixed with resin and cast into shapes and thin sections may be backed with plastic to give a smooth, shiny surface (Pedersen, 2004) **(FIGURES 3.7.19–3.7.20)**.

(A)

(B)

FIGURE 3.7.14 Jewellery made from sponge coral: **(A)** a pendant; and **(B)** earrings made from beads that have been impregnated with resin.



1 cm

FIGURE 3.7.15
(A)

1 cm

(B)

FIGURE 3.7.16
(A)

1 cm

1 cm

(B)

FIGURE 3.7.15 Items made from thin sections of sponge coral attached to a metal backing: (A) a cover sleeve for a cigarette lighter; and (B) a bracelet.

FIGURE 3.7.16 (A) a bracelet made from barrel-shaped sponge coral beads that have been impregnated with resin; and (B) a close-up view of the beads.

FIGURE 3.7.17
(A)

(B)

FIGURE 3.7.18
(A)

(B)

FIGURE 3.7.17 (A) a necklace made from spherical sponge coral beads that have been impregnated with resin and colour enhanced; and **(B)** a close-up view of the beads.

FIGURE 3.7.18 (A) a necklace made from tear-shaped sponge coral beads that have been impregnated with resin; and **(B)** a close-up view of the beads.

FIGURE 3.7.19

FIGURE 3.7.20
(A)

(B)

FIGURE 3.7.19 Beads that have been cast from fragments of sponge coral skeleton mixed with resin.

FIGURE 3.7.20 A close-up view of a bead that has been cast from fragments of sponge coral skeleton mixed with resin: **(A)** lit from the front; and **(B)** lit from behind to clearly show the opaque fragments set in translucent resin.

Similar Products

- Products made from *Heliopora* (blue coral) are sometimes advertised and sold as items made from Melithaeidae. Both taxa have a rough porous appearance; however, *Heliopora* is naturally blue in colour and exhibits well-defined individual pores rather than the distinctive sponge-like texture and vein-like banding of Melithaeidae (SEE SECTION 3.4 BLUE CORAL).

- Beads made from red lava rock may appear similar to specimens of Melithaeidae due to their colour and coarse texture, but the rock is consistently solid (no nodes and internodes) and lacks the distinctive sponge-like texture and vein-like banding of Melithaeidae **(FIGURE 3.7.21)**.

- Beads and other products made from Scleractinia (stony coral) may be dyed a red colour similar to the natural colour of Melithaeidae, but the red colour can be removable by applying a solvent. Additionally, stony coral products will be composed of solid calcium carbonate (not differentiated into nodes and internodes) and will not exhibit the distinctive sponge-like texture and vein-like bands of Melithaeidae (SEE SECTION 3.8 STONY CORAL).

- Specimens of Coralliidae that have been damaged by boring sponges will have a spongy appearance (Cattaneo-Vietti and Bavestrello, 2010) superficially similar to the texture of Melithaeidae. However, the damage will not be consistent through the entire specimen and there will be no vein-like banding as is distinctive to specimens of Melithaeidae (SEE SECTION 3.6 RED AND PINK CORAL).

FIGURE 3.7.21 Coarse beads made from red lava rock.

3.8
STONY CORAL

Scleractinia

3.8.1
FINGER CORAL

Porites

3.8.2
FOSSIL CORAL

Scleractinia

3.8.3
STAGHORN CORAL

Acropora

3.8 Stony Coral
Scleractinia Bourne, 1900

FIGURE 3.8.1 Whole dried stony coral (Scleractinia) skeletons showing a variety of colonial forms: **(A)** bird's nest coral (*Seriatopora*); **(B)** lettuce coral (*Agaricia*); **(C)** bubble coral (*Plerogyra*); **(D)** moonstone coral (*Favia*); and **(E)** cauliflower coral (*Pocillopora*).

Other Common Names

ENGLISH	Madreporaria
FRENCH	Madrépores
JAPANESE	Ishi sango
SPANISH	Corales pétreos

Taxonomy

Currently there are approximately 1,500 species described in the order Scleractinia (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, Feb. 16, 2011). The classification of the order, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Zoantharia de Blainville, 1830 (=Hexacorallia)
ORDER Scleractinia Bourne, 1900

Distribution

- Species of Scleractinia are found throughout the world, including tropical, temperate and polar oceans (Budd *et al.,* 2010).

- About one-half of the corals in the order Scleractinia are (mainly colonial) reef-building corals occurring in the clear, shallow waters of the tropics. The other half is comprised largely of solitary corals which occur in all regions of the oceans (Budd *et al.,* 2010).

Box 3.8 Note Regarding Scleractinia

During the course of researching and preparing this guide, all of the Scleractinian beads seen in trade and examined by the authors were identified as being made from the skeletons of the genera *Acropora* or *Porites.* However, users of this guide should keep in mind that other genera of Scleractinia could also be utilized and appear in international trade. They could be expected to appear very similar in colour and texture and would mainly be distinguished through the size and morphology of the corallites.

Multinational Conservation Status

- In 1986, the order Scleractinia was listed on Appendix II of CITES (UNEP-WCMC, 2010). Fragments (and sand) of Scleractinia that cannot be identified to genus are exempt from the provisions of CITES through two resolutions agreed to by the Parties: Resolution Conf. 9.6 (Revised) and Resolution Conf. 11.10 (Revised CoP 15) (CITES, 1994; CITES 2000). Therefore, very small beads or other items made from pieces of stony coral that do not exhibit the characteristics necessary for identification would be exempt from CITES (V. Fleming, UK Joint Nature Conservation Committee, *in litt.* to E. Cooper, February 28, 2011). Fossil coral (including all Scleractinia) is specifically noted as not being subject to the provisions of the Convention (CITES, 2000; CITES, 2010) (see additional comments in section 3.8.2 Fossil Coral).

- As of 2010, the order Scleractinia was listed on Annex B of the EC Wildlife Trade Regulations (*Commission Regulation (EU) No 709/2010 on amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein*) (Anon., 2010).

- A total of 837 species of reef Scleractinia were assessed in the 2010 IUCN Red List of Threatened Species. The assessed status of species of Scleractinia included “Critically Endangered” (six species); “Endangered” (23 species); “Vulnerable” (199 species); “Near Threatened” (174); and “Least Concern” (289 species); with 146 species assessed as “data deficient” (IUCN, 2010).

- In March 2011, Canada, China, Japan, the Republic of Korea, the Russian Federation, the United States of America, and Taiwan concluded negotiations on the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The interim text included a specific prohibition on the directed fishing of the order Scleractinia (NPO10, 2011). The Convention will come into force once it has been ratified by at least four Parties, at which point all of the Parties bound by its regulations will be prohibited from commercially harvesting specimens of Scleractinia in waters outside of their respective exclusive economic zones.

Characteristics

- The skeletons of Scleractinia vary greatly in shape—from solitary corallites to massive branching or plate-like forms (Oliver, 1986b) **(FIGURE 3.8.1)**.

- The composition of a skeleton of Scleractinia is calcium carbonate exclusively in the form of aragonite (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, Feb. 16, 2011).

- A characteristic of the Scleractinia is that the living polyps are supported by a cup in the skeleton known as a corallite[9]. In a dried specimen the corallites form distinctive craters in the surface of the skeleton. The morphological features of corallites are important characteristics in the taxonomy of Scleractinia. Key features include the theca (the wall enclosing a corallite), septa (partitions set radially within a corallite), the columella (a vertical central structure), costae (sections of the septa that extend past the theca), and the coenosteum (the area of skeleton between the corallites) (Budd *et al.,* 2010) **(FIGURES 3.8.2–3.8.3)**.

- Skeletons of Scleractinia may be porous (perforate) or solid (imperforate) (Galloway *et al*., 2007).

- The surface of the skeleton is hard and typically has a matte appearance. However, processed products (e.g. beads) may appear quite polished, especially if made from an imperforate skeleton (SEE SECTIONS 3.8.1 FINGER CORAL AND 3.8.3 STAGHORN CORAL).

[9] *Heliopora* (blue coral) also has corallites which appear as circular pores in the suface of the skeleton. See section 3.4 Blue Coral.

Characteristics (Continued)

- The colour of a dried skeleton of Scleractinia is usually a uniform white or off-white. Beads made from Scleractinia are often dyed bright colours. These colours may be removed by applying a solvent (SEE SECTION 3.8.3 STAGHORN CORAL).

- A hot-point test on a skeleton of Scleractinia will produce no significant result.

Trade

- Live colonies of Scleractinia occur in the aquarium hobbyist trade, and whole dried colonies are traded as curios (UNEP-WCMC, 2010).

- Various shapes of beads made from Scleractinia have become common in international trade, often dyed a variety of colours. Finished products include pendants, bracelets, necklaces, etc. (SEE SECTIONS 3.8.1 FINGER CORAL AND 3.8.3 STAGHORN CORAL).

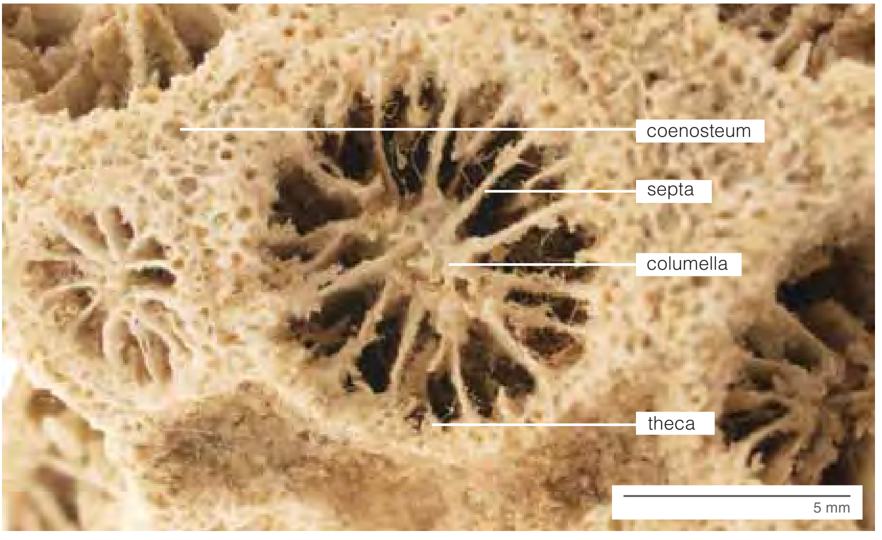
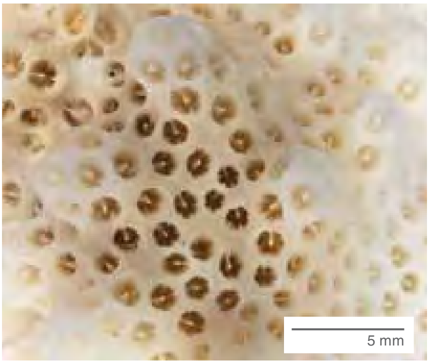
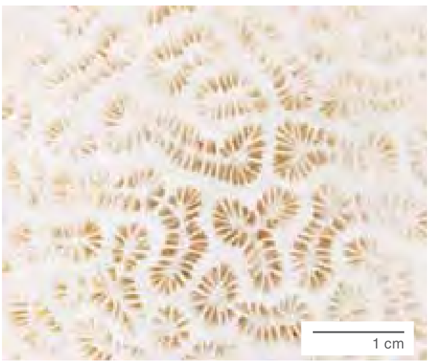


FIGURE 3.8.2 A close-up view of a dried skeleton of a moonstone coral (*Favia*) showing the basic morphology of a corallite.



(A)

(B)



(C)

(D)

FIGURE 3.8.3 Examples of the variation in corallite morphology in the skeletons of different coral taxa: **(A)** cauliflower coral (*Pocillopora*); **(B)** lettuce coral (*Agaricia*); **(C)** brain coral (*Platygyra*); and **(D)** mushroom coral (*Fungia*).

3.8.1 Finger Coral
Porites Link, 1807

FIGURE 3.8.1.1 (A–E) Whole dried finger coral skeletons showing a variety of colonial forms.

Other Common Names

ENGLISH Blue crust coral; branched finger coral; branching coral; club finger coral; clubtip finger coral; finger coral; honeycomb plate coral; hump coral; jewelled finger coral; lichen coral; lobe coral; mound coral; mustard hill coral; nodule coral; plate and pillar coral; solid coral; thin finger coral

FRENCH Coraux à pores; porite digitée; porite étoile; porite nid d'abeille

SPANISH Coral crustoso azul; coral de dedos chatos; coral de dedos finos; coral dedo; coral mostaza; coral panal; coral ramificado de dedos

Taxonomy

As of 2010, at least 60 species in the genus *Porites* had been described (IUCN, 2010). The classification of the genus, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
SUBCLASS Zoantharia de Blainville, 1830 (=Hexacorallia)
ORDER Scleractinia Bourne, 1900
SUBORDER Fungiina Verrill, 1865
FAMILY Poritidae Gray, 1842
GENUS *Porites* Link, 1807

Synonyms

Synaraea Verrill, 1864 (ITIS, 2010)

Distribution

- Colonies of *Porites* are widely distributed in tropical seas (Hickson, 1924) in the Indo-Pacific regions and the Atlantic and West Indies. In the Indo-Pacific they are one of the most common massive and branching corals (Bruckner, 2002).

Multinational Conservation Status

- See section 3.8 Stony Coral for a discussion of the multinational conservation of all species in the order Scleractinia (including *Porites*).

- A total of 60 species of *Porites* were assessed in the 2010 IUCN Red List of Threatened Species. The assessed status of *Porites* species included "Critically Endangered" (one species); "Endangered" (three species); "Vulnerable" (12 species); "Near Threatened" (12 species); and "Least Concern" (25 species); with seven species assessed as "data deficient" (IUCN, 2010).

Characteristics

- Colonies of *Porites* vary greatly in form and may be encrusting, massive and hemispherical in shape, branching or foliaceous, or may form plates and columns (Bruckner, 2002; Hickson, 1924). The tips of branched forms are blunt knobs and the branches are generally thick (Hickson, 1924) **(FIGURE 3.8.1.1)**.

- The composition of the skeleton of *Porites* is calcium carbonate exclusively in the form of aragonite, as is characteristic of all Scleractinians (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, Feb. 16, 2011).

- The skeleton of *Porites* is highly perforate and below the surface usually has the appearance of an intricate lattice-work (Hickson, 1924) **(FIGURE 3.8.1.2)**.

- The corallites of *Porites* are less than four millimetres in diameter (Bruckner, 2002). They are numerous, and have common polygonal-shaped thecal walls (there is no coenosteum) (Hickson, 1924) **(FIGURE 3.8.1.3)**. Each corallite has 12 similar-sized septa which are profusely perforated and lattice-like and the columella is reduced to a single spine (Hickson, 1924).

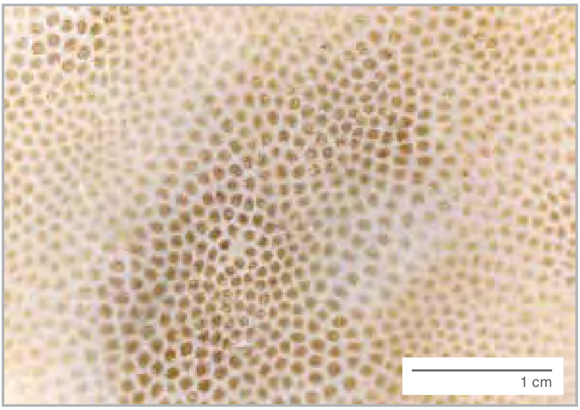
- The surface of the skeleton is hard but due to the high porosity will not appear polished. Beads made from *Porites* resemble polystyrene plastic in appearance **(FIGURE 3.8.1.4–3.8.1.5)**.

- The colour of a dried skeleton of *Porites* is a uniform white or off-white. Beads made from *Porites* are often dyed bright colours **(FIGURE 3.8.1.4–3.8.1.5)**. These colours may be removed by applying a solvent.

- A hot-point test on the skeleton of *Porites* will produce no significant result.

FIGURE 3.8.1.2

FIGURE 3.8.1.3
(A)



(B)

FIGURE 3.8.1.2 A close-up view of a cross-section of a finger coral skeleton showing the porous, lattice-like structure.

FIGURE 3.8.1.3 (A) branches of a skeleton of finger coral; **(B)** a close-up view of a skeleton showing the morphology and distribution of the corallites.

FIGURE 3.8.1.4

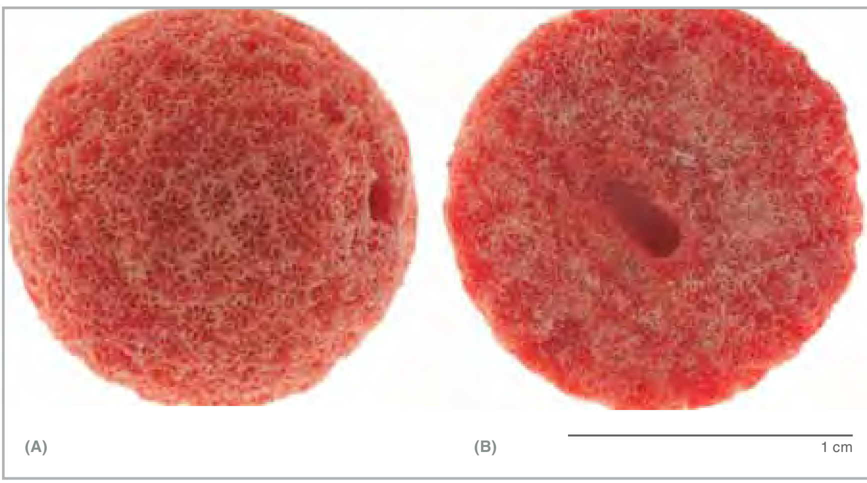


FIGURE 3.8.1.5

FIGURE 3.8.1.4 Round beads made from pieces of finger coral skeleton that have been dyed red, possibly to imitate sponge coral (Melithaeidae).

FIGURE 3.8.1.5 Close-up views of a round bead made from finger coral skeleton that has been dyed red and clearly show the characteristic polygonal-shaped corallites and porous, lattice-like morphology: **(A)** the whole bead; **(B)** a cross-section of the bead.

Trade

- *Porites* are traded as raw skeletons, and as specimens, carvings and derivatives. Live *Porites* colonies also occur in the aquarium hobbyist trade (UNEP-WCMC, 2010). *Porites* beads, of various shapes, are not uncommon in international trade.

- Beads made from *Porites* skeletons may be dyed a variety of colours and may be marketed as "limestone" or "acid-washed coral." Often beads made from *Porites* are dyed a mixture of red and yellow and marketed as "apple" coral. Finished products could include pendants, bracelets, necklaces, etc.

Similar Products

- Items made from *Heliopora* (blue coral) may appear similar to those of *Porites* due to the consistency of their skeletons and porous surface texture. However, *Heliopora* is naturally blue in colour and has distinct surface pores; whereas clean skeletons of *Porites* are white in colour (although products may be dyed various colours) and exhibit a distinctive (microscopic) lattice-work appearance. In addition, the corallites of *Porites* have septa whereas the corallites of *Heliopora* do not (SEE SECTION 3.4 BLUE CORAL).

- Beads made from *Porites* may be marketed as "apple" or "sponge" coral. These beads may be distinguished from true sponge coral (Melithaeidae) by the lack of vein-like gorgonin nodes, the presence of corallites, and the fine lattice-work appearance in contrast to the coarse sponge-like texture of melithaeid skeletons. In addition, skeletons of *Porites* are naturally white in colour whereas those of Melithaeidae are normally reddish (SEE SECTION 3.7 SPONGE CORAL).

3.8.2 Fossil Coral
Scleractinia Bourne, 1900

FIGURE 3.8.2.1

1 cm

FIGURE 3.8.2.1 Fossil coral bead, tentatively identified as *Goniastrea* (A. Budd, University of Iowa, *in litt.* to E. Cooper, May 1, 2011).

Other Common Names

FRENCH	Corail fossile
JAPANESE	Kaseki sango
SPANISH	Coral fósil

Taxonomy

It is not always possible to determine the taxonomic origin of a piece of fossil coral. Given the large amounts of skeletal material produced by the reef-building stony corals (Scleractinia) it would be safe to assume that much of the fossil coral excavated for use in jewellery would be of stony coral origin. Pedersen (2004) suggests that the fossil coral in trade are either of the order Scleractinia or of two extinct orders: Rugosa or Tabulata. During the course of researching and preparing this document many fossil coral beads were seen in trade and examined by the authors. Some could be identified to genus (e.g. *Favia*), while others exhibited insufficient biological information. However, all of the specimens that could be identified were clearly from specimens of Scleractinia.

Box 3.8.2 Note Regarding Fossil Coral

Merriam-Webster (2010) defined the term "fossil" as the remains, impression or trace of an organism from past geological ages. Le Tissier and Scoffin (2001) defined the term as "organic traces buried by natural processes and subsequently permanently preserved." Fossil coral therefore is a very broad term that could refer to whole specimens of coral or just a pattern in stone, and could include a vast number of taxa. Given that trade in fossil coral is not a conservation issue, no effort was made to define the characteristics for identifying fossil coral any further than Scleractinia. For enforcement purposes, the most important requirement is the ability to distinguish fossil from recent (non-fossil) coral, which may be very difficult (if possible) in many cases.

Multinational Conservation Status

- As previously noted, fossil coral in trade as jewellery products are most likely to be specimens of Scleractinia. In 1986, the order Scleractinia was listed on Appendix II of CITES (UNEP-WCMC, 2010). However, fossil coral is specifically noted as not being subject to the provisions of the Convention (CITES, 2000; CITES, 2010). The challenge is that there is no agreed definition of what constitutes a fossil coral under CITES. At CITES CoP 13 the Parties were asked to inform the CITES Secretariat as to how they interpreted the fossil annotation (V. Fleming, UK Joint Nature Conservation Committee, *in litt.* to E. Cooper, February 28, 2011). Responses were received from China, Mexico, Switzerland, the USA and the European Commission (on behalf of the 25 Member States of the European Union) and were included in Notification 2006/063 (CITES, 2006). Those Parties that responded take very different approaches to the definition of fossil coral.

- As of 2010, there was no international regulation of trade in fossil coral.

Characteristics

- A distinctive characteristic of the order Scleractinia is that the living polyps are supported by a cup in the skeleton known as a corallite. In a non-fossil specimen, the corallites form distinctive craters in the surface of the skeleton (Budd *et al.,* 2010). Specimens of fossil coral may or may not exhibit corallites. However, none of the fossil coral beads examined by the authors while researching this guide had crater-like corallites. All of the specimens had a smooth polished surface with the corallites exhibited as a pattern in the stone rather than a crater **(FIGURES 3.8.2.1–3.8.2.4)**.

- The colour of the fossil coral beads in trade typically ranges from tan to brown, but may be yellowish or pink (Pedersen, 2004). The colour is not usually consistent throughout the specimen and dark staining and imperfections are common **(FIGURES 3.8.2.1–3.8.2.4)**. In some cases, fossil coral beads are dyed brighter colours. None of the specimens examined by the authors exhibited the pure white colour of recent (non-fossil) specimens of Scleractinia (SEE SECTION 3.8 STONY CORAL).

- Le Tissier and Scoffin (2001) recommended, for the purposes of CITES implementation, the following definition of fossil coral: “A fossil coral will be dead and buried permanently, additionally it may be lithified [changed to stone] and may be mineralogically altered.”

FIGURE 3.8.2.2

1 cm

FIGURE 3.8.2.3

1 cm

FIGURE 3.8.2.2 Fossil coral beads. Note the dark staining and imperfections, and the impression of corallites that may be readily observed.

FIGURE 3.8.2.3 Fossil coral beads. The two beads on the left are tentatively identified as *Diploria* and the two on the right are tentatively identified as *Isophyllia* (A. Budd, University of Iowa, *in litt.* to E. Cooper, May 1, 2011).

FIGURE 3.8.2.4 Fossil coral beads, tentatively identified as *Montastraea* (A. Budd, University of Iowa, *in litt.* to E. Cooper, May 19, 2011).

Trade

- Fossil coral beads are not uncommon in international trade. Flattened lozenge-shaped beads are popular as they readily display the attractive pattern formed by the remains of the corallites. Finished products include pendants, bracelets, necklaces, etc. **(FIGURE 3.8.2.5)**.

Similar Products

- Beads made from various types of stone may be similar in colour and consistency to beads made from fossil coral. Only fossil coral will exhibit the patterns formed by the remains of corallites.

- Beads made from recent *Acropora* (or other Scleractinia) skeletons will exhibit true corallites that form craters in the surface of the specimen whereas fossil coral beads typically exhibit patterns of corallites with a smooth surface. In addition, recent beads made from Scleractinia that have not been dyed are a pure white colour rather than the brownish and stained colours characteristic of fossil coral (SEE SECTIONS 3.8.1 FINGER CORAL and 3.8.3 STAGHORN CORAL).

(A)

(B)

FIGURE 3.8.2.5 (A) a necklace made from spherical fossil coral beads and a rectangular fossil coral pendant; **(B)** a close-up view.

3.8.3 Staghorn Coral
Acropora Oken, 1815

FIGURE 3.8. 3.1 a dried specimen of a branched form of staghorn coral.

Other Common Names

ENGLISH Bluetip coral; bottle-brush coral; branching coral; bush coral; bushy coral; brush coral; catch bowl coral; Christmas coral; elkhorn coral; finger coral; flower coral; fuzzy table coral; hump coral; knobby coral; stony coral; table coral; tree coral; white coral; Yonge's coral

FRENCH Corail cornes de cerf; corail cornes d'élan; corail de staghorn

JAPANESE Midori ishi

SPANISH Coral córneo fundido; coral cuerno de alce; coral cuerno de ciervo; cuerno de ciervo

Taxonomy

As of 2010, at least 169 species had been described in the genus *Acropora* (IUCN, 2010). However, Wallace (1999) only lists 117 valid species.[10] The classification of the genus, sourced from Fautin and Romano (2000) and ITIS (2010), is summarized as follows:

CLASS Anthozoa Ehrenberg, 1834
- SUBCLASS Zoantharia de Blainville, 1830 (=Hexacorallia)
  - ORDER Scleractinia Bourne, 1900
    - SUBORDER Astrocoeniina Vaughan and Wells, 1943
      - FAMILY Acroporidae Verrill, 1902
        - GENUS *Acropora* Oken, 1815

Synonyms

Madrepora Linnaeus; *Heteropora* Ehrenberg, 1834 (Wallace, 1999)

[10] Wallace (1999) is considered to be the taxonomic authority for *Acropora* (S. Cairns, Smithsonian Institution, *in litt.* to E. Cooper, July 6, 2011).

Distribution

- The genus *Acropora* can be found in the Atlantic, Pacific, and Indian Oceans and in the marine waters of all continents with the exception of Europe and Antarctica (IUCN, 2010).

- Species of *Acropora* are primarily distributed in coral reefs but a small number may be found in areas of sub-tidal rocks, rocky reefs, loose rock, pebbles and gravel (IUCN, 2010).

- Corals in the genus *Acropora* are the most abundant and diverse genus of corals in the Indo-Pacific (Bruckner, 2002).

Multinational Conservation Status

- See section 3.8 Stony Coral for a discussion of the multinational conservation of all species in the order Scleractinia (including *Acropora*).

- A total of 169 species of *Acropora* were assessed in the 2010 IUCN Red List of Threatened Species. The assessed status of *Acropora* species included "Critically Endangered" (two species); "Endangered" (three species); "Vulnerable" (48 species); "Near Threatened" (22 species); and Least Concern (27 species); with 67 species assessed as "data deficient" (IUCN, 2010).

Characteristics

- The skeletons of *Acropora* vary greatly in shape—from plates to slender or broad branches. The degree of branching ranges from short and stubby to bushy and tree-like **(FIGURE 3.8.3.1)**. Some species grow in a horizontal plane forming flattened table-like colonies (Oliver, 1986a). Branching forms may exhibit different shapes such as arborescent (tree-like with few secondary branches), bottlebrush (having a main stem with numerous short branches) and cespitose (compact bushy colonies) (Bruckner, 2002).

- The composition of the skeleton of *Acropora* is calcium carbonate primarily in the form of aragonite (Wendt, 1990). This composition is common to all Scleractinia.

- *Acropora* is distinguished by the presence of prominent corallites that are raised 1–3 millimetres above the coenosteum, giving the branches a "bumpy" appearance (Bruckner, 2002) **(FIGURES 3.8.3.1–3.8.3.2)**. *Acropora* is also characterized by having single, usually slightly enlarged corallites at the tip of each branch (the apical corallites) and smaller, more numerous corallites (the radial corallites) situated along the branches. The radial corallites are never more than a few millimetres across (Wallace *et al.,* 2007; Oliver, 1986a) (**FIGURE 3.8.3.2)**.

- The surface of the skeleton is hard and typically has a matte appearance. However, processed products (e.g. beads) may appear quite polished **(FIGURE 3.8.3.3)**. Remnants of the corallites are typically still visible after polishing **(FIGURES 3.8.3.3–3.8.3.4)**.

- The colour of a dried skeleton of *Acropora* is a uniform white or off-white. Beads made from *Acropora* are often dyed bright colours **(FIGURES 3.8.3.5–3.8.3.8)**. These colours may be removed by applying a solvent **(FIGURE 3.8.3.6)**.

- A hot-point test on a clean skeleton of *Acropora* will produce no significant result.

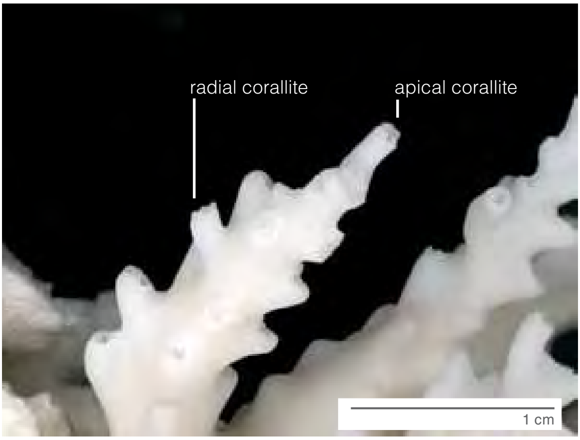


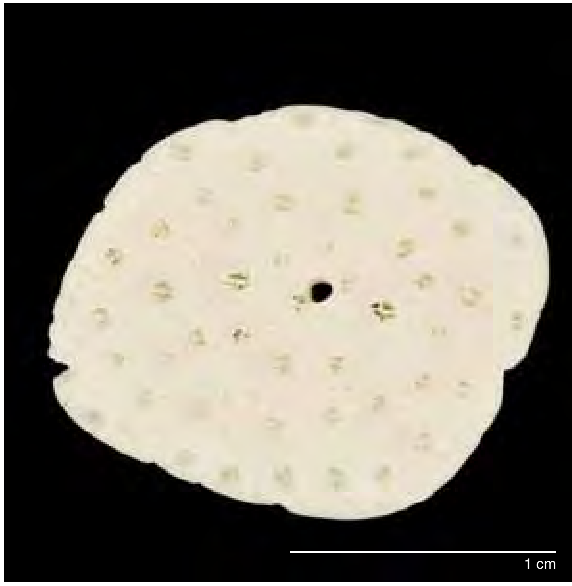
FIGURE 3.8.3.2 Close-up views of clean dried branches of staghorn coral showing the distribution and morphology of the corallites.

(A)

(B)

(C)

FIGURE 3.8.3.3 Naturally coloured beads made from pieces of staghorn coral skeleton: **(A)** spherical; **(B)** organically-shaped; and **(C)** hourglass-shaped.



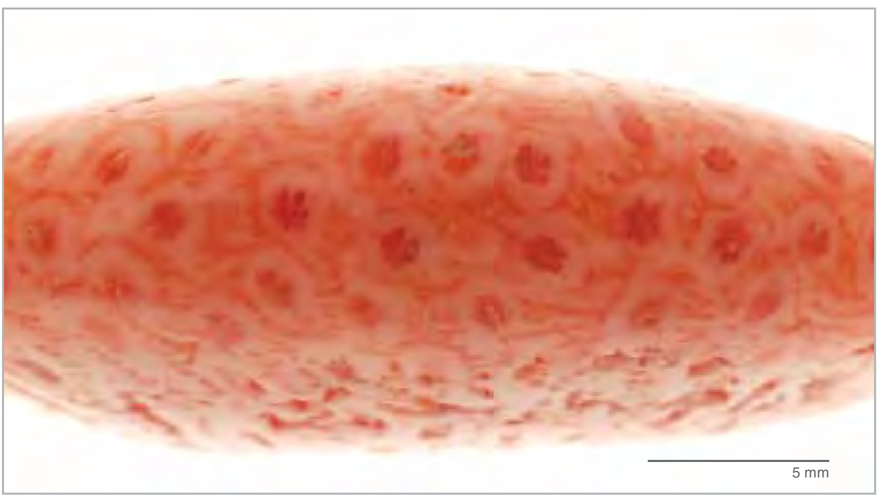
(A)

(B)

1 cm

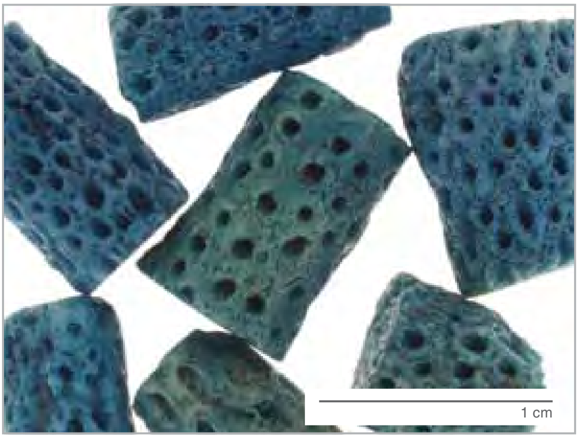
FIGURE 3.8.3.4 A close-up view of a flattened, organically-shaped and naturally coloured bead made from staghorn coral that clearly shows the remnants of corallites: **(A)** lit from above; and **(B)** lit from behind.

(A)

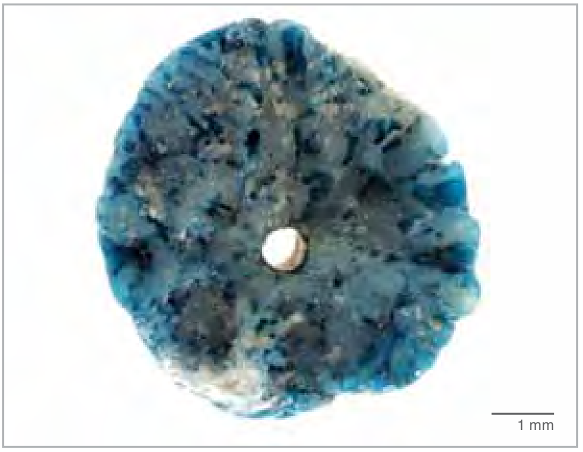


(B)

FIGURE 3.8.3.5 Disk-shaped beads made from pieces of staghorn coral skeleton that have been dyed a bright pink colour: **(A)** whole beads; and **(B)** a close-up view of the edge of one bead showing remnants of the corallites.



(A)



(B)

(C)

FIGURE 3.8.3.6 (A) beads made from pieces of staghorn coral skeleton that have been dyed blue, possibly to imitate blue coral (*Heliopora*); **(B)** a close-up view of a cross-section of a single bead showing that the dye has not consistently penetrated to the centre of the bead; **(C)** a cotton swab soaked in acetone-free nail polish remover that has been used to remove some dye from a bead.

Trade

- Live colonies of *Acropora* occur in the aquarium hobbyist trade, and whole dried colonies are traded as curios (UNEP-WCMC, 2010).

- Beads of various shapes made from *Acropora* have become common in international trade, often dyed a variety of colours and marketed as "flower coral". Finished products include pendants, bracelets, necklaces, etc. **(FIGURES 3.8.3.7–3.8.3.8)**.

Similar Products

- Products made from *Heliopora* (blue coral) may appear similar to those of *Acropora* due to the consistency of their skeletons and surface texture. However, *Heliopora* is naturally blue in colour and has corallites that appear as deep circular pores in a porous surface rather than the distinctive shallow corallites of *Acropora* and other Scleractinians (SEE SECTION 3.4 BLUE CORAL).

- Beads made from lava rock have a coarse surface consistency, but the lava rock is never white in colour and lacks the distinctive corallites of *Acropora* and other Scleractinia **(FIGURE 3.8.3.9)** (SEE ALSO SECTION 3.4 BLUE CORAL, **FIGURE 3.4.16**; and SECTION 3.7 SPONGE CORAL, **FIGURE 3.8.3.21**).

- Plastic beads may be similar to *Acropora* in colour; however, plastic will not display corallites and is readily scratched or damaged whereas products made from *Acropora* are very hard. A hot-point test on plastic will produce the smell of burning plastic or sour milk.

(A)

(B)

FIGURE 3.8.3.7 (A) a necklace created from dyed, teardrop shaped beads made from pieces of staghorn coral skeleton; and **(B)** a close-up view of the beads.

(A)

(B)

(C)

FIGURE 3.8.3.8 (A) a necklace made with dyed, spherical beads made from pieces of staghorn coral skeleton; **(B)** a close-up view; **(C)** a close-up view of a single bead showing remnants of the corallites.

FIGURE 3.8.3.9 Beads made from black lava rock.

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Notes

Notes

Quick Identification Reference Table

	Common Name	Scientific Name	Skeleton Morphology			Hot-point Test Results	Manufactured Items
			Surface	Texture	Natural Colour		
	Alaskan gold coral	*Primnoa*	Longitudinal ridges	Solid	Golden brown to brown	Smell of burning hair	
Bamboo Coral	Bamboo coral	Isididae	Longitudinal ridges	Solid	Internodes: White to beige Nodes: brown to black	Internodes: no reaction Nodes: smell of burning hair	Typically dyed a variety of colours, especially red
Bamboo Coral	Jointed coral	*Isis*	Longitudinal ridges	Solid	Internodes: White to beige Nodes: brown to black	Internodes: no reaction Nodes: smell of burning hair	Typically dyed a variety of colours, especially red
Black Coral	Black coral	Antipatharia	Small spines	Solid	Dark brown to black	Smell of burning hair	Spines not typically present on polished pieces
Black Coral	Golden coral	Antipatharia	Small spines	Solid	Dark brown to black	Smell of burning hair	Natural colour altered to a shiny gold; spines not present on polished pieces
	Blue coral	*Heliopora*	Pores	Porous	Grey blue to deep blue	No reaction	Surface pores may be filled with resin
	Hawaiian gold coral	*Gerardia*	Fine dimples	Solid	Golden	Smell of burning hair	
	Red and pink coral	Coralliidae	Longitudinal ridges	Solid	White, pink, salmon, orange, red	No reaction	
	Sponge coral	Melithaeidae	Sponge-like	Porous	Internodes: orange-red Nodes: yellow or brown	Internodes: no reaction Nodes: burning smell	Surface pores may be filled with resin
Stony Coral	Stony coral	Scleractinia	Corallites	Solid or porous	White	No reaction	Often dyed a variety of colours
Stony Coral	Finger coral	*Porites*	Corallites	Solid	White	No reaction	Often dyed a variety of colours
Stony Coral	Fossil coral	Scleractinia	Smooth	Solid		No reaction	
Stony Coral	Staghorn coral	*Acropora*	Corallites	Porous	White	No reaction	Often dyed a variety of colours