CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Fourteenth meeting of the Conference of the Parties
The Hague (Netherlands), 3-15 June 2007

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of all species in the genus *Corallium* in Appendix II of CITES. This taxon comprises 26 closely related species.

The current status of *Corallium* meets the conditions of Article II, paragraph 2(a) of CITES and satisfies Criterion B in Annex 2 a of Resolution Conf. 9.24 (Rev. CoP13). Regulation of trade in *Corallium* is required to ensure that the harvest of specimens from the wild is not reducing wild populations to levels at which survival might be threatened by continued harvesting or other influences.

Corallium spp. are not currently listed on the IUCN Red List of Threatened Animals.

B. Proponent

United States of America

C. Supporting statement

1. Taxonomy

1.1 Class: Anthozoa

1.2 Order: Gorgonacea (Alcyonacea)

1.3 Family: Coralliidae

1.4 Genus, species or subspecies, including author and year: *Corallium* (26 species). See Table 1.

1.5 Scientific synonyms: *C. rubrum*: *Madrepora rubra* Linnaeus, 1758; *Isis nobilis* Pallas, 1766; *Gorgonia nobilis* Linnaeus, 1789; *C. secundum*: *Pleurocorallium* Gray, 1867; *C. johnsoni*: *Hemicorallium* Gray 1867; *C. lauuense: C. regale* Baco and Shank, 2005. Recent taxonomic revisions divide the family Coralliidae into two genera, *Corallium* and *Paracorallium* (Bayer and Cairns, 2003).

1.6 Common names:
English: pink coral, red coral, noble coral, angel skin coral, Sardinia coral, midway coral
French: corail rouge, Corail Sardaigne, Coral Sciaca
Spanish: coral rojo, Coral Cerdeña
Japanese: Aka Sango (red), Momo Iro Sango (pink), Shiro Sango (white)

1.7 Code numbers: 3Alpha Code: COL

2. Overview

Corallium, the most valuable of the precious corals, has been fished for over 5,000 years. Millions of items and thousands of kilograms per year are traded internationally as jewelry and in other forms (Section 6). International demand drives serial depletions of *Corallium* as new stocks are discovered and rapidly exhausted (Section 5). Commercial yields of precious coral (all species) peaked in 1984 at 450 metric tons (mt), declining to 40 mt by 1990, and fluctuating between 28 and 54 mt over the last 15 years (Section 4.4). New technology in jewelry manufacture, where small fragments of coral are ground into a powder and mixed with synthetic resins to form a paste, has led to new, often illegal, patterns of exploitation involving removal of all colonies in an area, including undersized colonies.

Corallium spp. exhibit life-history characteristics that make them vulnerable to overfishing, including a sessile (attached) growth form, slow growth rates, relatively late reproductive maturity, reproductive output that increases with size (age), long life spans, and limited dispersal potential (Section 3.3). Beds of *Corallium* are discrete, genetically isolated units that occur in restricted, deepwater habitats. Populations are primarily self recruiting, exhibit low rates of gene flow, and are separated by large areas of unsuitable habitat and high currents. Commercial harvest has decreased genetic diversity within and among populations of *Corallium,* reduced colony densities, and shifted size and age structure to populations dominated by small, immature colonies. In addition, use of bottom trawls and dredges in the *Corallium* fishery and in food fisheries destroys bottom features and removes all benthic sessile organisms in their paths, causing extensive damage to coral ecosystems (Section 4.1). Management measures implemented in U.S. waters around Hawaii and in parts of the Mediterranean for *Corallium* fisheries include no-take areas, quotas based on maximum sustainable yield (MSY), licensing, and restrictions on non-selective gear types. These measures are absent from other locations, including international waters.

3. Species characteristics

3.1 Distribution

Corallium species are found throughout the world in tropical, subtropical and temperate oceans, including the Atlantic Ocean (n = 5), the Mediterranean Sea (n = 1), the Indian Ocean (n = 2), the Eastern Pacific Ocean (n = 3), and the Western Pacific Ocean (n = 15) at depths ranging from 7 to 1,500 m (Bayer and Cairns, 2003; Grigg, 1974; Weinberg, 1976). The only known populations of *Corallium* large enough to support commercial harvest are found north of 19º N latitude, including seven species harvested in the Western Pacific and one collected in the Mediterranean; all *Corallium* spp. identified in the southern hemisphere occur at low abundances. *Corallium rubrum* is endemic to the Mediterranean and eastern Atlantic, occurring primarily around the central and western basin (7-300 m depth, but most common at 30-200 m) with smaller populations in deeper water (60-200 m) in the eastern basin and off the Atlantic coasts of Africa around the Canary Islands, southern Portugal and around the Cape Verde Islands (Weinberg, 1976; Chiuntiroglou et al., 1989; Garrabou et al., 2001; Santangelo et al., 2004). Western Pacific *Corallium* populations extend from Japan to the northern Philippines (19ºN – 36º N) and from the Hawaii islands (20º N) to Milwaukee Banks (36ºN; approximately 3,800 km) (Grigg, 1974). This includes 1) populations of *C. japonicum*, *C. konjoi, C. secundum* and *C. elatius* in Japanese waters off the Bonin Islands; on banks between Okinawa and the island of Taiwan; off Pescadores Islands near the island of Taiwan; and in the South China Sea; and 2) populations of *C. lauuense* (*C. regale)*, *C. secundum* and *C.* sp. nov. in international waters around the Emperor Seamounts and Milwaukee Banks near Midway Island; and in 16 locations in the U.S. Exclusive Economic Zone (EEZ) off Hawaii (Grigg, 2002; Parrish and Baco, in press). Western Pacific *Corallium* beds are found at two depth zones (90-575 m and 1000-1500 m) (Grigg, 1974; Baco and Shank, 2005). Isolated colonies of *Corallium* also occur off Australia, the Solomon Islands, Vanuatu, Fiji, Kiribati, Tonga, Samoa, and the Cook Islands at 200-500 m depth (Harper, 1998); in international waters on the New England Seamount Chain (Atlantic Ocean); and in waters of the United States off Florida (in *Lophelia* beds in the Florida Straits), California (Davidson Seamount), Alaska (Gulf of Alaska Seamounts), Guam (Grigg, 1974; Tiffin, 1990; DeVogelaere et al., 2005; Etnoyer and Morgan, 2005), and three locations in American Samoa (Carleton, 1987) (Annex, Table 1).

3.2 Habitat

Corallium communities occur in geographically isolated and spatially confined deep water rocky bottom habitats, typically aggregating on banks and seamounts, under ledges, and in and around caves. Habitat requirements include strong bottom currents (1-3 knots), slopes of less than 20º, low rates of terrestrial sedimentation, and an absence of sediment accumulations. Light levels influence larval settlement and thus control the upper depth limit of their distribution. *C. rubrum* is found in semi-dark habitats known as the coralligenous zone, whereas other species are found below the euphotic zone. Environments colonized by *Corallium* also contain other suspension feeders such as branching scleractinian corals, octocorals, antipatharians, and sponges.

In the Pacific, the two richest depth zones for *Corallium* are 90-400 m and 1,000-1,500 m, primarily around seamounts and offshore shoals; colonies are most abundant adjacent to channels and on the outer rim of seamounts where currents are greatest. Different species of *Corallium* typically occur in non-overlapping habitats. *C. secundum* occurs on flat exposed substrates, whereas *C. lauuense* (*C. regale*) prefers encrusted uneven rocky bottom habitat. Both species are absent from shelf areas (< 400 m depth) off populated islands, where substrates are periodically covered by shallow lenses of sand and silt (Grigg, 1993).

In the Mediterranean, *C. rubrum* is the dominant component of the coralligenous zone and coexists with other gorgonians, large sponges and other benthic invertebrates. Colonies are most abundant in and around dimly lit caves, dark overhangs, vertical cliffs and crevices at depths less than 30 m, and occur as isolated colonies on exposed structures in deeper water (Marchetti, 1965). The vertical distribution extends above the thermocline; temperatures may vary by as much as 10ºC between depths and seasons.

3.3 Biological characteristics

Corallium spp. are benthic suspension feeders and consume primarily particulate organic matter, with occasional capture of larger zooplankton (copepods and crustaceans). All species lack symbiotic algae in their tissues (azooxanthellate). All species are k-selected deep-sea coral species with life-history characteristics that make them particularly vulnerable to over-exploitation, including extreme longevity (75-100 years), late age of maturity (7-12 years), slow growth (< 1 cm/year) and low fecundity. They are sessile colonial cnidarians with an arborescent growth form, attaining heights ranging from 50-60 cm (*C. rubrum*) to over 1 m (Pacific species). *Corallium rubrum* exhibits average growth rates of 0.2-2 cm/year in length and 0.24-1.32 mm diameter[1], with growth rates declining with age. Historically, *C. rubrum* colonies frequently attained masses greater than 2 kg and basal diameters of 3-10 cm. Colonies today rarely exceed 20 cm in height and 2 cm basal diameter, because commercial take has removed most large individuals (Barletta et al., 1968; Liverino, 1989). Growth rates (height) of *Corallium secundum* are about 0.9 cm/year; natural mortality rates vary between 4 and 7%, with turnover of populations occurring every 15-25 years (Grigg, 1976). Aspects of reproductive biology have been studied for *C. rubrum* and *C. secundum*. These species have separate sexes and an annual reproductive cycle. *C. rubrum* reaches maturity at 2-3 cm height and 7-10 year[2] age (Torrents et al., 2005; Santangelo et al., 2003); *C. secundum* reaches maturity at 12 year (Grigg, 1993). *C. rubrum* is a brooder with a short-lived passive larvae; *C. secundum* is a broadcast spawner. Planulation occurs once per year, primarily during summer. Larvae exist in the water column for a few days (4-12 days in the laboratory) before settling in close proximity to parent colonies (Santangelo et al., 2003). The density of recruits of *C. rubrum* can be fairly high

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[1] *Growth rates vary among locations, depths and habitats (Garcia-Rodríguez and Massò, 1986; Abbiati et al., 1992; Cerrano et al., 1999; Garrabou and Hamelin, 2002; Bramanti et al., 2005). Older records of growth rates were estimated by counting growth rings that were thought to be deposited annually. Measurements of growth based on staining of the organic matrix indicate that growth rates are about one fourth as fast and colony age may be up to ten times greater than documented previously (Marschal et al., 2004).*

[2] *In earlier studies, more than 50% of colonies were reported to reach sexual maturity at 2 year, and all colonies over 5 year were fertile. Recent aging studies suggest that these reports under-estimated the true age of reproductive maturity by 3-4 year (Marschal et al., 2004).*

(0-32 recruits/m^2 per year between 1995-1999 in Spain [Linares et al., 2000], and 0-12.5 recruits/m^2 per year between 1979 and 2000 in France [Garrabou et al., 2001]), although up to 95% of the larvae die before settling (Tsounis, 2005), and 66-70% of the new recruits die over the first four years of life (Bramanti et al., 2005). Local populations of *Corallium* spp. are self-seeding and genetically distinct (Santangelo and Abbiati, 2001; Santangelo et al 2004), with occasional long-distance dispersal events maintaining connectivity between sites (Baco and Shank, 2005).

3.4 Morphological characteristics

Corallium spp. are octocorals with a solid, longitudinally striated calcitic axial skeleton that is branched and fan-like or bushy shaped. Colonies range in color from pure white to shades of pink, salmon, blood red and orange, and have white transparent polyps with eight tentacles and fine pinnules. The central organic gorgonin found in other octocorals is replaced by a solid axis of fused calcareous spicules composed of a very hard calcium carbonate structure with a high magnesium content. Gross morphological characters and color easily distinguish the family *Coralliidae* from other coral families.

3.5 Role of the species in its ecosystem

Corallium spp. form tall, arborescent colonies that increase the three-dimensional complexity and consequently increase biodiversity where they occur. These colonies provide valuable habitat for sessile invertebrates by protecting them from strong currents and predators. They provide structural relief that fishes and mobile invertebrates use as feeding, spawning and resting grounds. *C. rubrum* is one of the dominant components of the Mediterranean coralligenous species assemblages, which are complex communities composed of a wide variety of suspension feeders, and a high species richness and functional diversity (Gili and Coma, 1998). At least one invertebrate (*Pseudosimnia* spp.) is a highly specialized gastropod known to lay eggs on *C. rubrum*. A rare palemonid crustacean (*Balssia gasti*) is only known from the Mediterranean, where it attaches to colonies of *C. rubrum* (Santangelo et al., 1993).

4. <u>Status and trends</u>

4.1 Habitat trends

Deep-water *Corallium* habitats have been impacted by dredges and trawls used to collect corals as well as trawl fisheries targeting seamount and deep sea associated fishes. These gear types scour the bottom, resuspend sediment and cause incidental damage to corals through removal as bycatch. With the exception of limited harvest by submersibles off Hawaii, and recent (since the 1950s) selective collection using SCUBA in the Mediterranean, most coral has been harvested using heavy dredges consisting of nylon netting tied to an iron bar or cement stones that are dragged across the ocean floor. In this process, coral is entangled in the nets and pulled to the surface. The process is destructive and wasteful because nets often break and dislodge coral, much of which is lost and subsequently dies. Moreover, the dredging operation destroys all sessile invertebrates in its path, including undersized precious corals of low value that are subsequently discarded, creating a barren topography devoid of life. In the Western Mediterranean, non-selective coral fisheries have degraded the three-dimensional structure created by *C. rubrum* to a "grass-plain"-like structure from the original forest-like structure that was still apparent 20 years ago (Garcia-Rodríguez and Massò, 1986; Tsounis et al., 2006).

4.2 Population size

Corallium spp. occur primarily at a low abundance, with the only known larger, commercially exploitable populations reported from the Mediterranean and western Pacific (Grigg, 1974; 1993; 2002). *Corallium rubrum* is found in small patches at relatively high abundances (127 colonies/m^2 in Spain [Tsounis, 2005]; 200-600 colonies/m^2 in France [Garrabou et al., 2001]; and up to 1300 colonies/m^2 in the Ligurian Sea, Italy [Cerrano et al., 1999]) in shallow water (10-30 m), and occurs as isolated colonies in deeper water. At Costa Brava, Spain (20-50 m depth), patch size is small (0.43 m^2) and number of patches is relatively few (0.063 patches/m^2), and overall abundance of *C. rubrum* was estimated at 3.4 colonies/m^2 (Tsounis, 2005). Several decades ago, densities of 55 colonies/m^2 were observed at a depth of 40 m (Palma de Malloca), 20 colonies/m^2 at 60 m depth along the Costa Brava, and 90-100 colonies/m^2 in Corsica (FAO, 1984). Deep-water precious coral beds in the United States off Hawaii are found in 16 known areas at depths of 380-575 m (Annex, Figure 1), three of which were assessed in 2001 (Grigg, 2002; Baco and Shank, 2005). The largest bed (Makapu'u Bed in the Molokai Channel off Oahu; 4.3 km^2) is dominated by *C. secundum* at densities of 0.3 colonies/m^2, with an overall population size of about 120,000 colonies. Keahole Point Bed covers an area of 0.96 km^2 and contained up to 7,000 legal-sized *C. lauuense* colonies. The summit of Cross Seamount (6 km in diameter) has a series of volcanic pinnacles and ridges dominated by *Gerardia* spp. and smaller populations of *C. lauuense* consisting of about 2,500 legal-size colonies); *C. secundum* was also present, but in very low numbers (Grigg, 2002).

4.3 Population structure

The size and age structures of virgin (unfished) *Corallium* populations in steady-state recruitment are structured by a monotonic curve with a negative exponent (Santangelo et al., 1993). A severe lack of older individuals, as observed in all areas with *Corallium* fisheries where surveys have occurred, is an indicator of high mortality due to natural causes or harvesting. *Corallium rubrum* forms dense, patchy assemblages consisting of small (mean size = 3 cm), short-lived (< 10 years) colonies in shallow water; less than half of these are reproductive, most of which produce tens of planulae per year. In deeper water, *C. rubrum* colonies are larger but less abundant. Large, older colonies may produce hundreds to over 2,000 planulae per year (Santangelo et al., 2003). In non-harvested areas, recruitment rates ranged from 0 to 32 recruits/m^2 per year between 1995 and 1999 (Linares et al., 2000), and 0 to 12.5 recruits/m^2 per year between 1979 and 2000 at a different site (Garrabou et al., 2001). Populations of *C. japonicum* in Makapu'u Bed (Hawaii) were dominated by colonies that were 15-20 years old; the largest colonies were 70 cm in height and 80 years old, and natural mortality rates in absence of fishing were estimated at 6% (Grigg, 1984; 1993).

4.4 Population trends

Global harvest statistics from 1950 to 2001 provide one indication of the rapid decline in abundance of Mediterranean and Pacific species corresponding with the discovery, inception of commercial fishing, increase in landings, overexploitation, and, ultimately, exhaustion of the resource (Annex, Table 2; Figures 2; 3; 4; U.N. FAO/FIGIS, 2006). For example, a large bed of *Corallium* discovered in 1978 on the Emperor Seamounts (900-1500 m) was fished by over 100 coral boats during peak years (1979-1981) and production neared 300 metric tons (mt) (Grigg, 1993). The resource was rapidly depleted; by 1989 yield dropped to less than 10 mt (Annex, Figure 4).

Throughout the Mediterranean, *C. rubrum* populations have shown a dramatic decrease in their size, age structure and reproductive output over the last 20 years, and the only remaining commercially valuable beds are now found along the African coasts from Morocco to Tunisia, in the Bonifacio Strait off western Sardinia and along the Spanish coasts. Most remaining populations in shallow water are characterized by the absence of large colonies, and an overall shift to non-reproductive colonies below the smallest legal size for commercial harvest (mean size throughout the region is now 3 cm; Liverino, 1989; Garrabou and Harmelin, 2002). In Spain, 89% of the colonies in fished areas were below legal size for harvest, 96% showed only rudimentary branching patterns (primary and secondary branches only) and 91% were less than 5 cm in height (Tsounis et al., 2006). The mean basal diameter of colonies declined from 7.2 mm to 4.8 mm, and the mean height decreased from 61.8 mm to 27 mm between 1986 and 2003 (Tsounis et al., 2006). Even in areas that have been protected from fishing for over 14 years, the largest colonies were rarely found to exceed 20 cm and the average basal diameter was only 4.8 mm, corresponding to an average age of 7.5 years (Tsounis et al., 2006). In Italy, approximately two-thirds of a well-studied population was non-reproductive (Santangelo et al., 2003). In France, colony size (basal diameter and height) in non-harvested sites was four times larger and the average height was two times greater than that of corals in harvested areas (Garrabou and Harmelin, 2002).

In 1971, before commercial harvest, the total population of *C secundum* in Makapu'u Bed (off Hawaii) was estimated at 79,200, with colonies occurring at a mean density of 0.02 colonies/m^2 (Grigg, 1976). Between 1974 and 1979 about 40% of the standing stock (17,500 kg) was harvested (Grigg, 1988). Six years after harvesting ceased, colony densities were similar to pre-harvest levels (0.022 colonies/m^2), although colonies were younger and smaller, and colonies over 35 years of age were absent. By 2001, the percent of older size classes (20-45 years) increased, but the oldest colonies (45-55 years) were still under-represented (Grigg, 2002)[3].

4.5 Geographic trends

Most western Pacific populations of *Corallium* have been depleted within 4–5 years of their discovery, leading to a termination of fishing or a relocation of fishing effort as new beds have been discovered. Mediterranean populations of *C. rubrum* off Calabria, Naples, Sardinia, Corsica, and parts of the French and Spanish seacoasts all had significant *Corallium* banks in the 1950s, but most have been over-exploited and are no longer commercially viable. *Corallium rubrum* has also been extirpated from one location east of Graham Bank (Sicily Channel) and from three banks off the coast of Sciacca (Strait of Sicily) that were discovered between 1875 and 1880 and fished until 1915 (Liverno, 1984; Geronimo et al., 1993).

5. Threats

The primary threat to *Corallium* is over-harvesting for the precious coral trade. For over 5,000 years, the precious coral industry has been characterized by boom and bust. In the Mediterranean, intensive harvesting within the last 200 years has caused a severe depletion of most commercial *C. rubrum* stocks (Garrabou et al., 2001; Santangelo et al., 1993). For example, a discovery of large beds between Sicily and Tunis in the 1880s led to an unprecedented rush of almost 2,000 vessels, which rapidly depleted the grounds (Tescione, 1973). Harvest of *C. rubrum* in the Mediterranean decreased by 66% between 1985 and 2001 (Annex, Figure 3; U.N. FAO/FIGIS, 2006). The current practice of harvesting coral in the Mediterranean with a minimum basal diameter of 7 mm indicates colonies are only 11 years old. This prevents colonies from realizing their maximum potential reproductive output. For example, in a site that was last harvested in 1977, the largest colonies had not yet reached commercial size 23 years later (Garrabou and Harmelin, 2002).

Rapid over-exploitation of *Corallium* beds shortly after their discovery is also reported for most fishing grounds in the western Pacific. This occurred near Okinawa at the Miyako grounds in 1963 (Morita, 1970). In 1965, Japanese coral fishermen discovered a large pink coral bed at 400 m depth on the Milwaukee Banks in the Emperor Seamount Chain (Grigg, 1993). The harvest of *Corallium* first peaked in 1969, when Pacific production reached 150 metric tons, and then fell precipitously and remained low for the next years until a deep-water species was discovered at depths of 900-1,500 m (Grigg, 1993). During the peak years of this fishery (1981), over 100 coral boats harvested up to 200 mt of *Corallium* annually from these seamounts. Yield declined precipitously in 1985 and ceased in 1989 because deep beds were exhausted (Western Pacific Regional Fishery Management Council, 2001; 2003; Grigg 2002).

Secondary human impacts include pollution, sedimentation, tourism and recreational diving (Mediterranean), and incidental take and habitat degradation associated with longline fishing and bottom trawling (western Pacific). The benthic impacts of mobile fishing gear have been likened to clear cutting techniques in old-growth forests (Watling and Norse, 1998). Longline fishing and bottom-trawling nets frequently remove octocoral colonies from the rocks and boulders they grow upon.

A mass mortality event in 1999 caused extensive mortality to shallow-water populations (< 30 m depth) along 50 km of coastline in the Provence region off France, with overall losses estimated in the millions of colonies. This unusual die-off was attributed to a fungal and protozoan disease and linked to temperature anomalies (Cerrano et al., 1999; Perez et al., 2000; Romano et al., 2000;

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3 *Grigg (2002) suggests that Makapu'u Bed increased in size by 20% and colony abundance was much greater in 2001 (0.3 colonies/m^2), compared to earlier surveys in the 1970s and 1980s. However, surveys were more extensive and covered areas that had not been previously examined.*

Garrabou et al., 2001). A comparable mass mortality event occurred in 1987 on deep reefs (>80 m depth) between Marseille and Nice (Rivoire, 1991), and in shallow populations at La Ciotat in 1983 (Harmelin, 1984). Other sources of mortality include smothering by sand, detachment and toppling caused by organisms that weaken the site of basal attachment, predation by gastropods (*Pseudosimnia* sp.), eucidarid sea urchins, and crustaceans (*Balssia* sp.) and encrustation by hexactinellid sponges, including at least 10 species of boring clionid sponges (Grigg, 1993; Garrabou et al., 2001).

6. Utilization and trade

Corallium, the most valuable genus of precious coral, is highly valued for jewelry and art objects. The value of *Corallium* depends on the species harvested (*C. rubrum, C. japonicum, C. lauuense, C. elatius, C. konojoi* and *Corallium* sp. Nov are most valuable), its size, color and condition when collected (from highest to lowest value: alive, dead but attached, dead but fallen, and "worm" eaten). According to Greek legend, *Corallium* confers such magical powers as overcoming evil, protecting crops, warding off epilepsy, defending ships against lightning, and eliminating hatred from the home, and it was used as an antidote for poison and for treating other ailments. Powdered *Corallium* skeleton, liquid tonics, granules and pills are sold as herbal or homeopathic medicine for use as an antacid, astringent, emmenagogue, nervine tonic, laxative, diuretic, emetic or antibilious agent.

6.1 National utilization

Precious corals in the genus *Corallium* are important deep-water resources that are harvested in the western Mediterranean Sea and in the western North Pacific Ocean, including traditional harvest areas off Japan and the island of Taiwan, Midway Island and Emperor Seamounts in international waters and Hawaii. In the Pacific, *Corallium* is harvested in two general depth zones, 200-500 m and 1,000-1,500 m; most harvest of *C. rubrum* in the Mediterranean is from 30 to 120 m depth. Commercial yields of precious coral (all species and locations) peaked in 1984 at 450 mt, declined to 40 mt by 1990, and has fluctuated between 28 and 54 mt over the last 15 years (Annex, Figure 4).

A fishery for *C. rubrum* existed in the Mediterranean for nearly 5,000 years, with supplies waxing and waning depending on supply (discovery of new beds), demand and political and economic stability of the surrounding countries. Some of the earliest records of use are from the Roman times when ground *Corallium* powder was used as an antidote for poison (Wells, 1981). In the 16th and 17th centuries Genoa and Naples (Italy) became the centers of the coral fishery, with most harvest occurring off the North African Coast. By 1870, most coral fishing in Italy had shifted to Torre del Greco, with smaller fisheries based out of Livorno, Genoa and Corsica (Torntore, 2002). Following discoveries of extensive coral banks off Sicily between 1875 and 1880, the number of boats increased (330), levels of harvest quadrupled, and numbers of processing factories increased from 40 to over 80. Until 1994, corals were harvested in the Mediterranean using dredges and nets, especially the Saint Andrew Cross (Council of the European Union, 1994). SCUBA (mixed-gas diving) collection was introduced in the 1950s; most effort today is directed at shallow depths (30-50 m), primarily between May and September (Tsounis, 2005).

Corallium fisheries started in the Pacific in waters surrounding Japan in 1804, and expanded through 1868, targeting grounds off Japan, Okinawa, the Bonin Islands and the island of Taiwan until 1965. Following discovery of *Corallium* beds on banks north of Midway Island in 1965, and over the next 20 years, most of the world's harvest came from the Milwaukee Bank and surrounding seamounts in the Emperor Seamount Chain. During the 1980s, three separate groups of coral fishermen operated out of Japan: coastal harvesters, submarine and robot harvesters, and the All Japan Coral Fisheries Association (JCFA). The total Japanese harvest decreased from over 55,000 kg in 1982 to only 3,000 kg in 1988. A much smaller fishery was initiated in U.S. waters off Hawaii in 1966, following the discovery of *C. secundum* off Makapu'u, Oahu. Using tangle-net dredges (heavy stone or iron bars with attached netting), approximately 2000 kg of *Corallium* was harvested between 1966 and 1969. Maui Divers of Hawaii, Inc., the leading manufacturer and retailer of precious coral jewelry in Hawaii, harvested coral from this bed between 1972 and 1978 using a manned submersible. Harvest was discontinued in 1978 due to high operating costs and a diving accident (Grigg, 2002; Annex, Table 4). In 1988, the domestic fishing vessel Kilauea used a tangle-net dredge to harvest beds at Hancock Seamount. Its catch consisted mostly of dead or low-quality pink coral, and the operation was soon discontinued. For the next 20 years, Hawaii relied on imports of *Corallium* from Japan and Chinese Taipei. The U.S. fishery was revived by American Deepwater Engineering in 1999-2000, using two one-person submersibles capable of diving to 700 m. In 2000, 1,216 kg *C. secundum* from the Makapu'u Bed and 61 kg of *C. lauuense* were collected from exploratory areas off Kailua, Kona (Grigg, 2002). No harvest occurred from 2001 to 2006. In 1969, Hawaii's precious corals industry produced approximately USD 2 million in retail sales, partially from domestic harvest and the remainder consisting of jewelry imported from Chinese Taipei and Japan (Grigg 1993, Simonds, 2003).

6.2 Legal trade

The trade in *Corallium*, primarily in the form of beads, dates to at least the Classical period and continued through the Middle Ages, with major exports from Rome to India. By the 17th century the major centers of the coral trade were in Naples, Marseilles and Livorno-Leghorn, with exports to India and West Africa. Exports of *C. rubrum* continued into the late 1800s, when Italy began importing large quantities of western Pacific *Corallium* from Japan and re-exporting processed coral beads to Asia and Africa (Torntore, 2002). Torre del Greco, Italy, currently sources 30% of their raw material from the Mediterranean with the remaining 70% coming from Japan and Chinese Taipei (Castiligliano and Liverino, 2004). The average annual value of coral exports from Torre del Greco amounted to nearly USD 30 billion in 1988 (Torntore, 2002). Superior beads fetch prices of up to USD 50 per gram and necklaces cost up to USD 25,000.

Centers for processing *Corallium* expanded in the 1970s to India, China, Japan and the United States. In 1982, the annual value of the pink coral industry in Chinese Taipei and Japan was about USD 50 million (Castiligliano and Liverino, 2004). Japan imported 28 mt in 1987 (USD 8 million), up 77% by quantity and almost 200% by value over 1983 coral imports; coral imports declined to 18 mt (USD 4.4 million) in 1988. Chinese Taipei has historically been the major supplier of coral to Japan, accounting for about 56% of the value of Japan's 1988 coral imports. France, Italy, Spain, and Tunisia also export coral to Japan. The United States is the number one consumer of precious corals (including *Corallium* spp.). Between 2001 and 2006, the United States imported unworked skeletons and processed *Corallium* products from 55 countries and territories, with most from China, Chinese Taipei and Italy (Annex, Table 4; Figures 5 and 7). Imports of *Corallium* products included over 26 million pieces and 51,456 kg of manufactured items, and 428,644 skeletons and 6,742 kg of raw (unworked) *Corallium* consisting of 5 species (*C. elatius, C. japonicum, C. nobile*, *C. rubrum* and *C. secundum*); *C. japonicum* was the dominant species in trade, whereas *C. nobilis* was the least common (Annex, Figure 6). Currently, the United States does not export products made from *Corallium*; however, a major source of consumer demand is Asian and American tourists visiting Hawaii.

6.3 Parts and derivatives in trade

Corallium is traded as 1) whole, dried colonies; 2) unworked branches and branch fragments; 3) beads and polished stones; 4) manufactured jewelry; and 5) powder, pills, granules, ointment and liquid. Historically, small colonies were rejected by the jewelry industry. Technological advancements enable small fragments to be ground into powder and mixed with synthetic resins to form a paste (FAO, 1984). This has led to new patterns of exploitation in the Mediterranean involving the removal of undersized corals, their basal attachment, and underlying substrate.

6.4 Illegal trade

Foreign poaching in U.S. waters has been a problem in the past. Some estimates suggest that nearly half of the global production during the 1970s and 1980s was poached from Hawaiian territorial waters. During the 1980s, coral vessels from Japan and Chinese Taipei continuously violated the U.S. EEZ near the Hancock Seamounts. In 1985, about 20 coral draggers from Chinese Taipei poached approximately 100 mt of *Corallium* from seamounts within the U.S. EEZ north of Gardner Pinnacles and Laysan Island (Grigg 1993). Poaching and illegal harvest of undersized corals by licensed fishermen is being reported with increasing frequency off Costa Brava, Spain (Zabala et al., 2003; Tsounis, 2005).

6.5 Actual or potential trade impacts

See Annex, Figures 5, 6 and 7.

7. Legal instruments

7.1 National

The European Union: Corallium rubrum is listed in Annex V of the European Union Habitats Directive. The Spanish Government has established reserves for the protection of *C. rubrum* in the Mediterranean Sea (Hunnan, 1980). In 1994, the European Union banned the use of dredging equipment for the harvest of *Corallium* in the Mediterranean (the *ingegno*, or St. Andrews Cross; Cicogna and Cattaneo-Vietti, 1993; Council Regulation No 1626/94; Council of the European Union, 1994). In 2006, the Spanish Ministry of Agriculture, Fisheries and Food published a new *Ministerial Order for the Integral Fisheries Management of the Mediterranean*, which bans the use of bottom trawling, purse seining and drag netting to 50 m depth.

The United States: The Western Pacific Fishery Management Council's (WPFMC) Precious Corals Fisheries Management Plan (FMP) has regulated the harvest of *Corallium* spp. since 1983. The FMP imposes permit requirements valid for specific locations, harvest quotas for precious coral beds, a minimum size limit for pink coral, gear restrictions, area restrictions, and fishing seasons. The Northwest Hawaiian Islands (NWHI) National Monument prohibits taking of precious coral (including pink and red coral) within the Reserve. The State of Hawaii prohibits the take or sale of pink coral without a permit and has established a minimum size (25.4 cm). California prohibits the commercial harvest of *Corallium* spp. Guam prohibits the commercial harvest of all coral species without a permit.

7.2 International

There are no international trade control or management measures for the genus *Corallium* (See Section 8.3.1).

8. Species management

8.1 Management measures

Although *Corallium* has been harvested for over 5,000 years, few management measures have been implemented and enforced, and patterns of fishing have been characterized by exploration, discovery, exploitation and depletion (Grigg, 1976). Management measures applied or proposed for *Corallium* fisheries over the last two decades have included prevention of illegal fishing, reduced quota of fishing licenses, size limits, gear restrictions, quotas, area closures, and rotation of harvest areas. Management has been hampered by problems associated with enforcement and jurisdiction, the multinational character of the fishery, presence of precious coral beds beds in the marine environment not under the jurisdiction of any State, and a lack of knowledge of the status of populations and the biology of *Corallium*.

8.2 Population monitoring

There are no comprehensive monitoring programs for *Corallium*.

8.3 Control measures

8.3.1 International

There are currently no binding international instruments for the conservation of *Corallium*; it is not listed on any international wildlife or fisheries agreements and has no international legal status. However, in 2004, the member States of the United Nations agreed to take urgent action for the protection of vulnerable marine ecosystems (VMES), such as coldwater corals, in accordance with the precautionary approach through, *inter alia*, the interim prohibition of destructive fishing practices, including bottom trawling, that has adverse impacts on VMES, on a case-by-case and scientific basis, until such time as appropriate conservation and management measures have been adopted. These measures, currently limited to non-binding U.N. General Assembly resolutions, could be greatly strengthened by CITES provisions. Such measures are important given that *Corallium* is not managed by any existing regional fisheries management organizations.

8.3.2 Domestic

See Consultations below.

8.4 Captive breeding

Currently there are no captive-breeding programs for *Corallium*. A laboratory for the biological, economic and technical research of precious corals was established in Kochi, Japan, in the early 1990s. Colonies of *C. japonicum* were maintained alive in culture for over one year but growth rates were very slow and no reproduction occurred (Sadao Kosuge, Director of the Institute of Malacology, Tokyo, 1992). A working group of the Stazione Zoologica di Napoli established a laboratory for the rearing and production of new propagules of *C. rubrum* in 1988. They have been conducting experiments on the feeding behavior of polyps, growth rates, sexual and asexual reproductive processes, recolonization rates and selection of artificial substrata for the settlement of larvae. In addition, recent efforts to rear *C. rubrum* on artificial substrates in the wild may assist in rehabilitating depleted populations (Cattaneo-Vietti et al., 1992).

8.5 Habitat conservation

A number of refugia are closed to harvest in the U.S. Pacific and in the Mediterranean.

8.6 Safeguards

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9. Information on similar species

Bamboo coral has recently appeared on international markets as jewelry, often being died pink or red and sold as *Corallium*. Features sufficient for reliable identification at the species level within the *Corallium* genus do not exist for skeletons or as manufactured jewelry and curios, which makes up the bulk of the trade. Taxonomic identification of octocorals requires microscopic analysis of shape, size and color of sclerites (tiny calcified skeletal elements) embedded in the coenochyme and in the organic matrix of the axial skeleton; these are lost when processed for jewelry.

10. Consultations

Algeria: Small fishery in existence. Colonies of *C. rubrum* must have a base with a minimum diameter of 8 mm.

Canada: *Corallium* has not been recorded in Canadian waters. There are no records of harvest or trade. *Corallium* has no legal status or regulations in Canada, and it has not been reported as bycatch.

Indonesia: The Genus *Corallium* occurs below 300 m depth, but no fishery exists. *Corallium* is not listed as a protected species. Harvest and trade (import/export) data are not collected.

Italy: Coral beds on the Sicilian and Tyrrhenian coasts are no longer commercially exploited because shallow populations have been extirpated and remaining colonies only found deep. Current harvest only occurs in Sardinia, with harvest regulated through a specific regional law requiring a license system and based on a management plan. Conservation concerns have triggered reductions in number of licenses and shorter harvesting period. Italy is a major importer of *Corallium* used mainly by jewelry designers and handicrafts. Italy supports the listing proposal.

New Caledonia (France): No special conservation status for *Corallium*, although the Norfolk Ridge Seamount is protected from fishing

New Zealand: All species of red coral are listed under Schedule 7a of the Wildlife Act 1953, "marine species declared to be animals", and are protected throughout New Zealand and New Zealand fisheries waters. The Act includes a general description of red coral, which includes *Corallium*, but there is some uncertainty regarding what species are actually covered. Existing fisheries regulations also require reporting of bycatch of deep-water corals within New Zealand-controlled fisheries areas.

United States of America: Wildlife and wildlife parts including corals of the genus *Corallium*, must be declared to the U.S. Fish and Wildlife Service upon importation into or exportation from the United States. In order to import or export items made from red corals for commercial purposes, the entity will need to be in possession of an import or export license which will allow them to trade in wildlife products. The importer must make sure that any collection or export is in compliance with the laws and regulations of that country prior to importation into the United States.

The Western Pacific Fishery Management Council's Precious Corals Fisheries Management Plan was implemented in 1983. The plan established the following management measures: permit requirements, harvest quotas for separate beds, a minimum size limit for pink coral, gear restrictions, area restrictions, and fishing seasons. Coral beds are treated as distinct management units and are classified as established beds, conditional beds, exploratory beds and refugia. Quotas are set for pink coral in four conditional beds (Keahole Point, 67 kg; Kaena Point, 67 kg; Brooks Bank, 444 kg; 180 Fathom Bank, 222 kg.); in one established bed (Makapu'u Bed, 2,000 kg); and in exploratory areas (1,000 kg quota for all species combined except black coral). Westpac Bed, Northwest Hawaiian Islands, is designated as a refugium with a zero quota. Legal harvest requires a minimum diameter of 2.54 cm and a height of 25.4 cm. Collection can only be done selectively, with either a Remotely Operated Vehicle (ROV) or submersible; tangle-net dredges were allowed until 1999, at a reduced quota (20% of selective harvest limits). The State of Hawaii also has minimum harvest size and permit requirements for state waters.

Slovenia: *Corallium* does not occur in the Adriatic Sea in Slovenian waters. Two temporary seizures of *Corallium* occurred: 150 g from Croatia in November 2004, and two products (a statue and a smoking pipe) in March 2006, but these were returned to the owners after determination that they were not internationally protected.

Spain: Red coral harvesting has been regulated since the mid-1980s and includes prohibitions on the use of the Barra Italiana (Saint-Andrew's Cross) and submarine vehicles, and a series of zones with rotational harvest and 12- to 15-year closures. Real Decreto (Royal Decree) 1212/84 and Order 3/1985 regulate allowable gear types and harvest levels with recent modifications to management measures in December 2005 by the Real Decreto 1415/2005 (regulating fisheries and commercialization of the species) and in May 2006 by the Order APA/1592/2006 regulating the proceedings for authorizations of this activity. Legal minimum harvest size (basal diameter) is 7 mm. Five legal harvest sites exist along Costa Brava (Begur, Montri, Cap de Creus South, East and North), with a closed area around Medas Islands. There are currently 70 licensed professional SCUBA divers for red coral extraction, specific allowable quantities and qualities, and reporting requirements. The genus is not included on the Spanish invertebrates Red List.

11. Additional remarks

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12. References

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Table 1: Species in the Family, *Coralliidae*. Species with * have been recently reassigned to a new genus, *Paracorallium* (Bayer and Carins, 2003). Species of commercial value are in bold. [3]Torntore (2002) refers to two undescribed species from Midway Island in deep water: garnet coral occurs at depths of 700-900 m and deep sea coral occurs at depths of 800-1500 m.

SPECIES	DISTRIBUTION	Depth (m)	CITATION
C. abyssale	Hawaii		Bayer 1956
C. borneense	Borneo		Bayer 1950
C. ducale	Eastern Pacific Mexico		Bayer 1955
C. elatius	W. Pacific; northern Philippines to Japan and island of Taiwan; Mauritius; Palau	150-330	Ridley 1882
C. halmaheirense	Indonesia		Hickson 1907
C. imperiale	Eastern Pacific; Baja California	600	Bayer 1955
*C. inutile**	Japan, Tonga[2]	100-150;300-350[2]	Kishinouye 1903
C. japonicum*	W. Pacific around Japan, Okinawa and Bonin Islands; Vanuatu[2]	80-300; 250-450[2]	Kishinouye 1903
C. johnsoni	Northeast Atlantic		Gray, 1860
C. kishinouyei	E. Pacific		Bayer 1996
C. konjoi	W. Pacific from Japan to northern Philippines; Palau; Chinese islands of Hainan, Solomon Islands[2]	50-200; 262-382[2]	Kishinouye 1903
C. lauuense (C. regale)	Hawaii	390-500	Bayer 1956
C. maderense	Eastern Atlantic		Johnson 1898
C. medea	Western Atlantic: Cape Hatteras to Straits of Florida; oceanic seamounts off Brazil	380-500	Bayer, 1964, Castro et al. 2003
C. niobe	Western Atlantic		Bayer, 1964
*C. nix**	New Caledonia	240	Bayer 1996
C. reginae	Indonesia		Hickson 1905
C. rubrum	Mediterranean and E. Atlantic: Greece, Tunisia, Corsica, Sardinia, Sicily, Portugal, Morocco, Canary and Cape Verde Islands.	5-300	Linnaeus,1758; Weinberg, 1978
*C. salomonense**	Chagos Archipelago, Indian Ocean	217-272	Bayer 1993
C. secundum	W. Pacific waters around Hawaii, Japan and island of Taiwan; Chinese islands of Hainan, in 'straights' of Hong Kong SAR	350-500 (few colonies at 230 m)	Dana 1846
*C. stylasteroides**	Mauritius; western Samoa[2]	136; 350-360[2]	Ridley 1882
C. sulcatum	Japan		Kishinouye 1903
*C. thrinax**	New Caledonia	240	Bayer and Stefani 1996
*C. tortuosum**	Pailolo channel, Hawaii, Tonga[2],	153-173; 325[2]	Bayer 1956
C. tricolor	Eastern Atlantic		Johnson 1898
***C. sp. nov*.** [3]	Midway Island to Emperor Seamounts	700-1500	Grigg, 1982

Figure 1. Locations of 16 precious coral beds in the Hawaiian Archipelago known to contain populations of *Corallium lauuense* and *Corallium secundum*. The size of the bed and the relative abundance of *Corallium* is indicated by the size of the pie diagram. Source: Hawaii Undersea Research Laboratory.

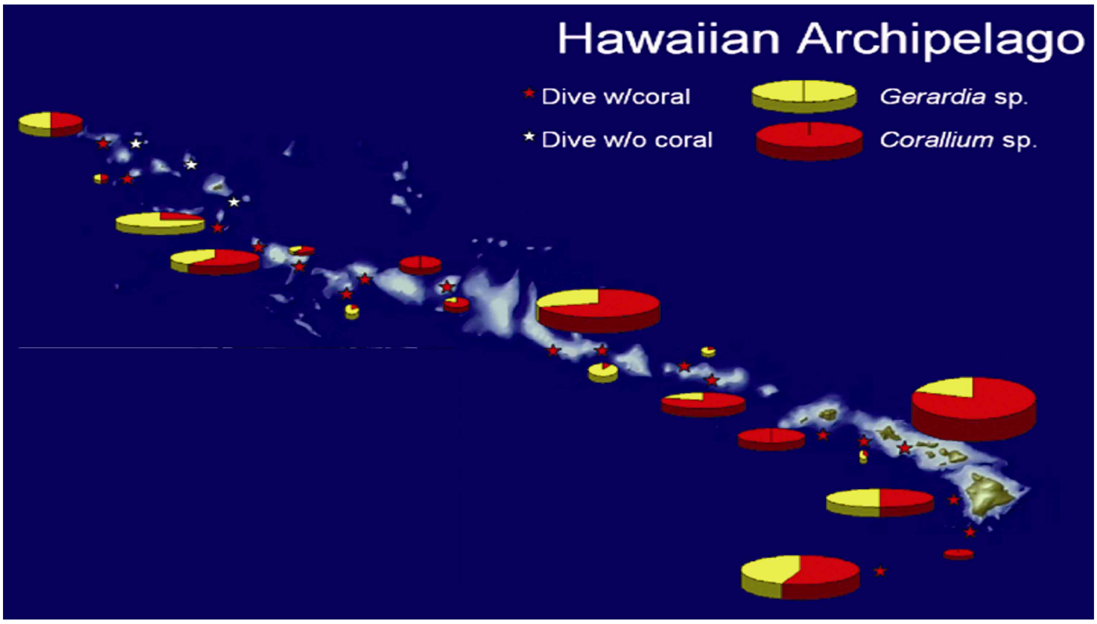

Table 2. Total harvest (kg) of *Corallium* from the Emperor Seamounts in the western Pacific. Japan's harvest for western Pacific and Midway grounds was through use of dredges, whereas harvest in all areas was by submersible. [1]Harvest data for Japan for both submersibles and dredges are combined in 1990 and 1991. Source: Grigg, 1993.

Year	Japan			Chinese Taipei
	Western Pacific	Midway grounds	All areas	All areas
1979	14,516	76,988	0	123,000
1980	10,227	74,228	0	154,000
1981	5,381	30,484	775	254,000
1982	3,000	52,166	551	69,200
1983	2,947	51,087	306	109,000
1984	3,315	33,164	634	157,000
1985	2,366	9,322	816	214,000
1986	1,268	1,650	1,261	141,000
1987	1,986	585	425	106,000
1988	1,605	217	1,082	50,000
1989	1,057	1,961	938	5,400
1990			2172[1]	1,000
1991			1390[1]	1,000

Figure 2. FAO *Corallium* spp. harvest data (1963 - 2004). Data for *C. japonicum*, *C. regale*, *C.* sp nov. , *C. elatius* and *C. konojoi* are pooled for the Pacific.

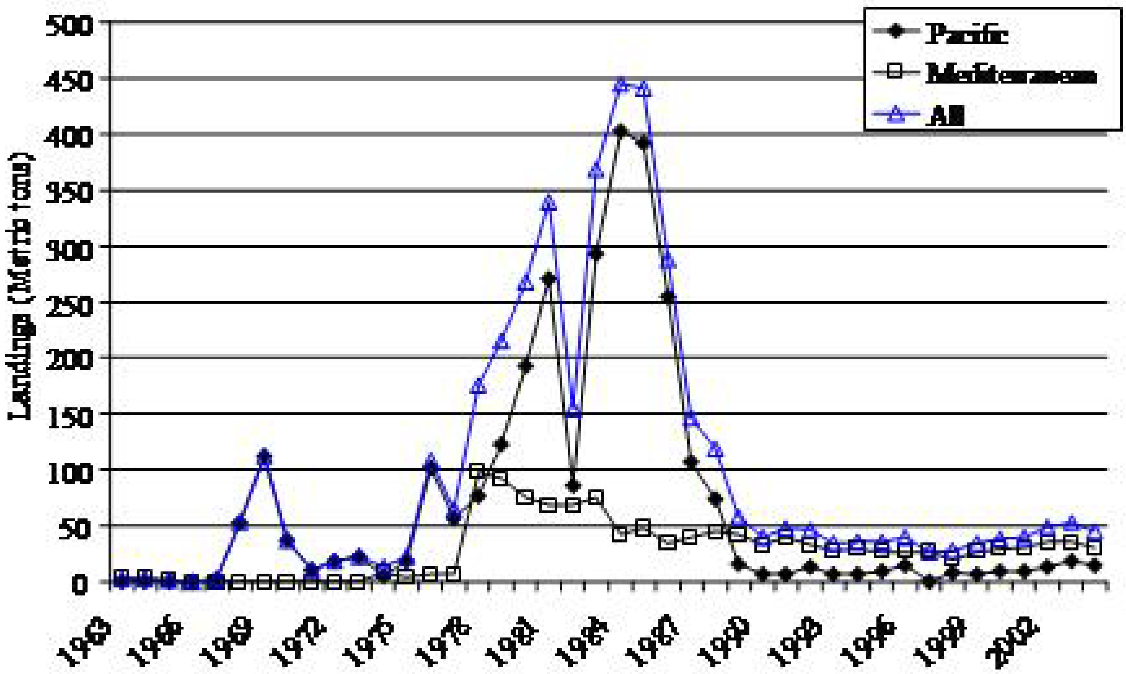

Figure 3. Harvest data for *C. rubrum* between 1962 and 2004. Data source: FAO, 2006.

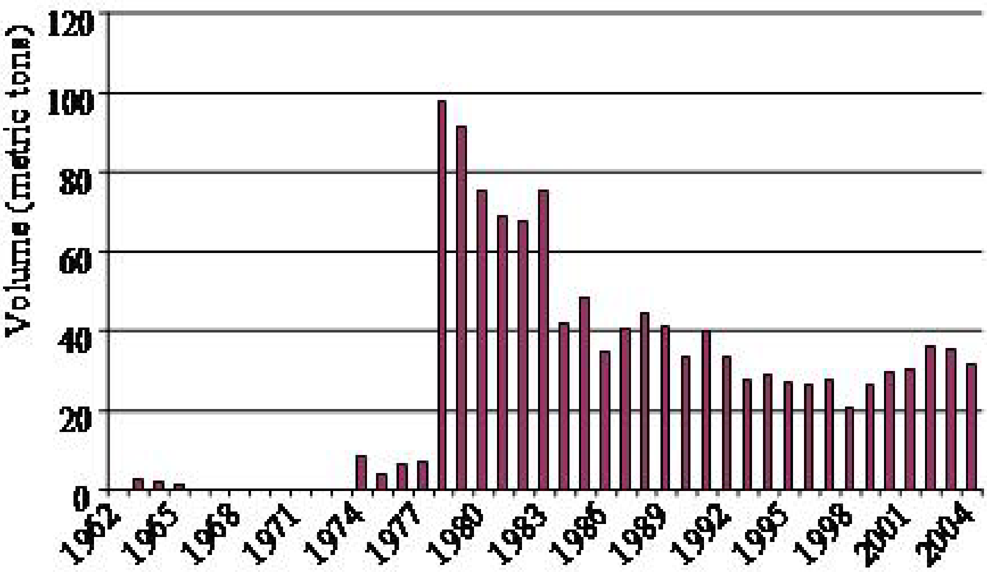

Figure 4. Harvest data for *Corallium* of individual species (source: FAO).

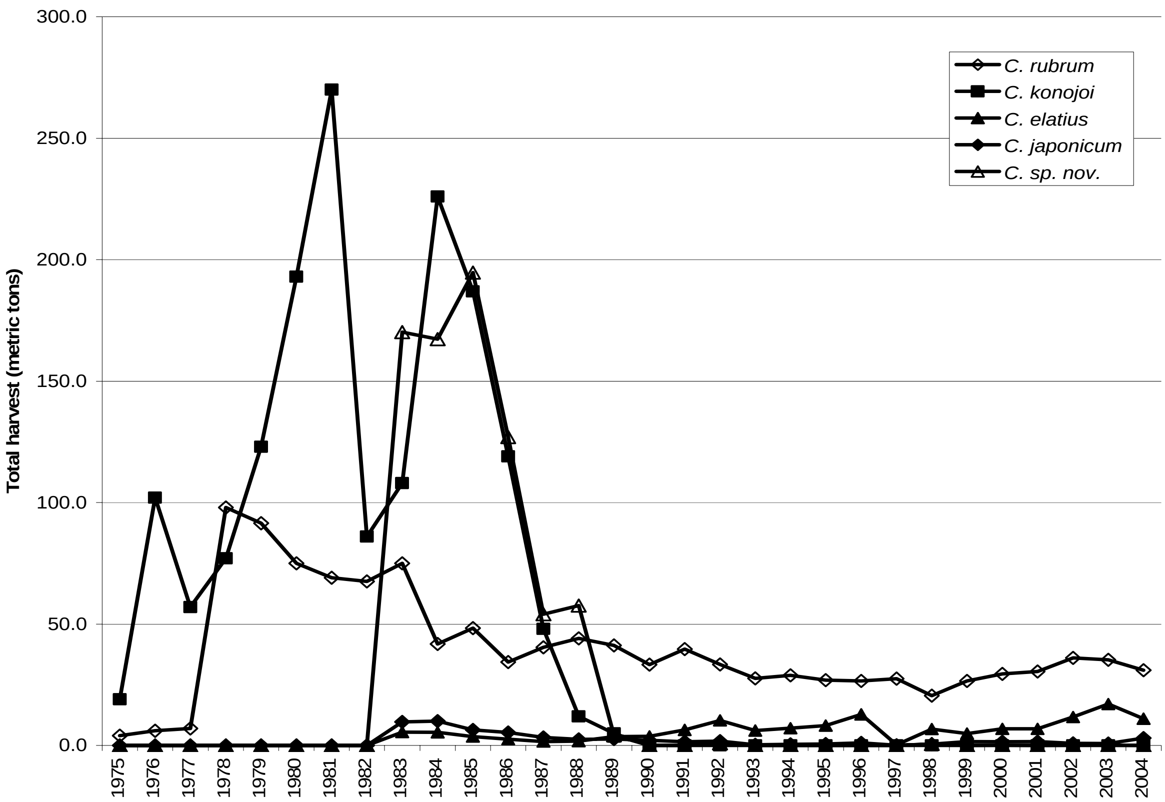

Table 3. Annual harvest of *C. secundum* from Makapu'u Bed, Hawaii, United States. Data for 1999-2000 include 61 kg of *C. lauuense* harvested from exploratory areas off Kailua, Kona. Source: Grigg, 1993.

Year	Gear	Harvest (Kg)
1966-69	Dredge	1,800
1970-72	No harvest	0
1973	Submersible	538
1974	Submersible	2,209
1975	Submersible	1,385
1976	Submersible	400
1977	Submersible	1,421
1978	Submersible	474
1979-1998	No harvest	0
1999-2000	Submersible	1,216
2001-2006	No harvest	0

Table 4. Volume of *Corallium* products (jewelry, carvings and other manufactured items reported by number of items) imported into the United States from 2001 to 2006. The top eight exporting countries and territories are shown; 47 additional countries are pooled under other. Data source: U.S. Fish and Wildlife Service.

	2001	2002	2003	2004	2005	2006	total
China	44,789	122,154	16,675,173	3,506,223	620,688	1,310,563	22,279,590
Chinese Taipei	628,889	244,135	398,067	264,541	437,670	207,048	2,180,350
Hong Kong SAR	15,296	23,175	0	0	78,101	7,827	124,399
Italy	303,085	422,148	144,927	82,227	68,261	63,946.5	1,017,800
Thailand	2,184	19,262	67,167	40,024	53,936	88,575	271,148
Philippines	12,653	2,134	834	652	1,667	74,700	92,640
Indonesia	679	1,818	3,996	28,439	14,309	25,032	74,273
Japan	25,173	6,523	6,340	10,817	11,790	5,888	66,531
Other	48,473	4,467	40,828	9,952	16,161	21,771	141,652
Total	1,083,222	847,818	17,339,335	3,944,879	1,304,588	1,807,357	26,248,383

Figure 5. Imports of *Corallium* products (jewelry, carvings and other manufactured items) into the United States between 2001 and 2006.

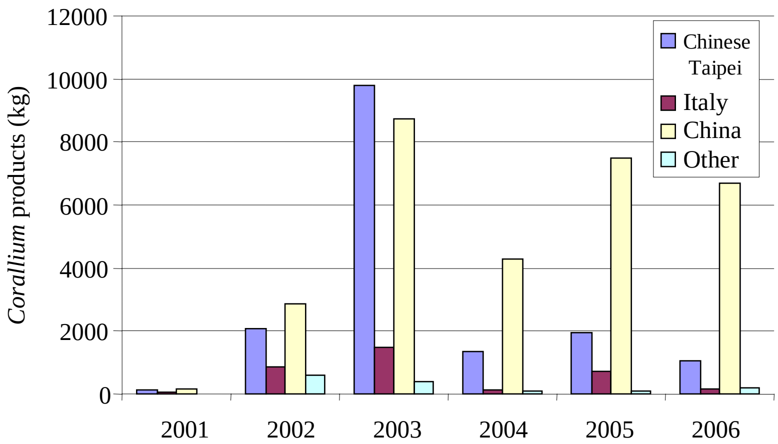

Figure 6. Annual imports of *Corallium* into the United States for each species. Unprocessed (raw) skeletons and manufactured items are pooled. **A**: Imports reported by number of specimens. **B**: Imports reported by weight.

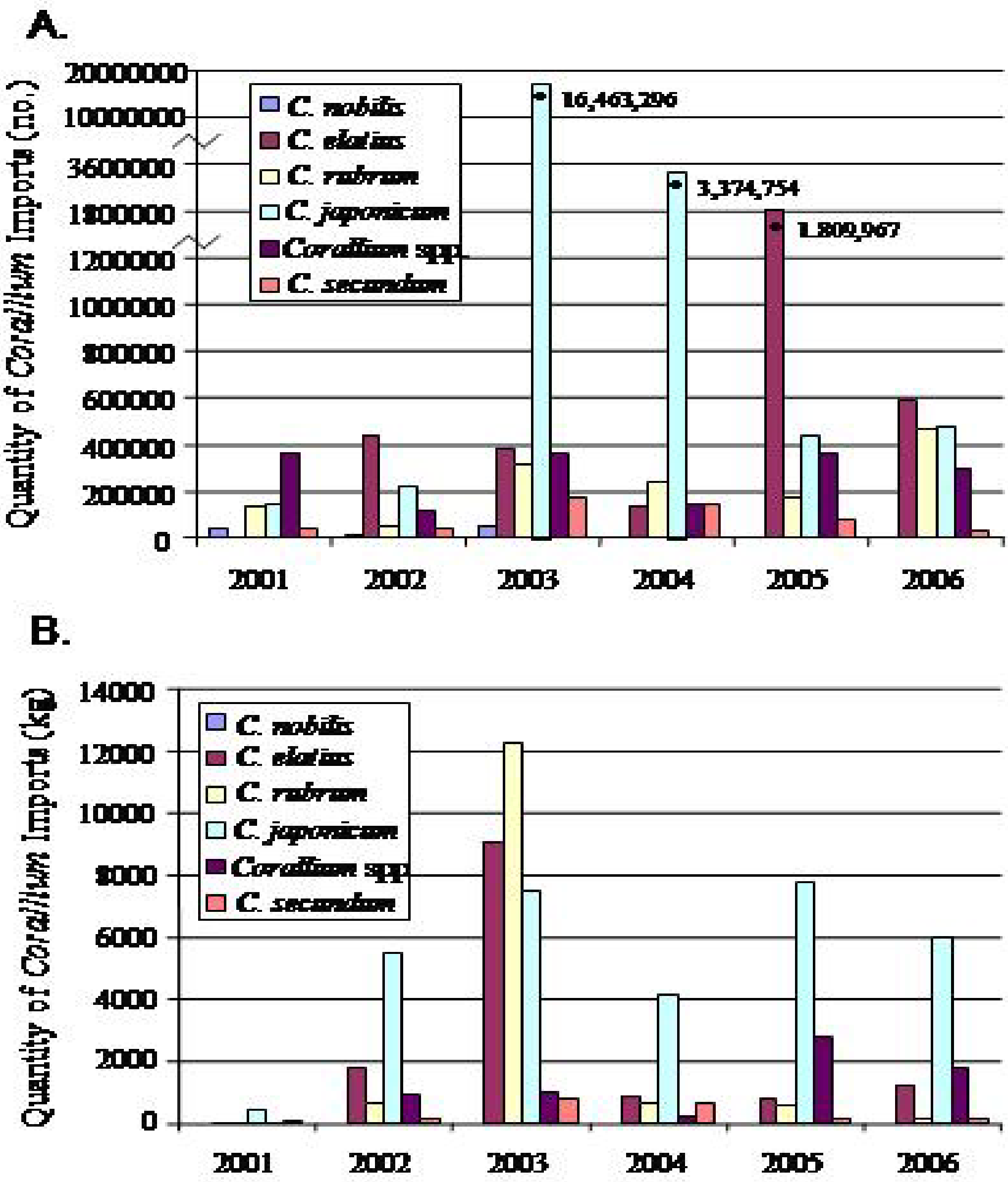

Figure 7. Imports of unprocessed *Corallium* skeletons into the United States between 2001 and 2006. **A**: *Corallium* skeletons reported by weight. **B**: *Corallium* skeletons reported by number of specimens. Data source: U.S. Fish and Wildlife Service import declarations.