TDA

Diving Association (THAILAND)

Full voting member of the world underwater federation

CMAS

The Artificial Reef Project

TDA Artificial Reef Project

Wrecks to Reefs

Artificial reefs are not, as you may have thought a recent idea, in fact artificial reefs have been realised now for centuries. This original idea was probably conceived from observations by fishermen of the increased density of fish life around sunken shipwrecks.
Following this, un-seaworthy vessels were towed out and scuttled in prime locations to attract more fish to the area. To see these ourselves as divers becomes more than apparent when we dive for example offshore. Not much life at all in the open but approaching a wreck reveals a much different story.
Now a days much more study and effort is put into artificial reefs, becoming an applied technology in its own right; Scientists able to predict species attraction to specific types of reef structure including wrecks.

ARTIFICIAL REEFS: WHAT ARE THEY...?

Artificial reefs are structures placed into the aquatic environment to mimic natural reef rock, but gain the advantage of time over natural production. These structures can be constructed to suit specific requirements in specific locations using a wide variety of materials to encourage the colonisation of marine life. Almost every conceivable item has been experimented with to find the optimum reef substrate: Cars, Ships, Tanks, Aircraft, Concrete, Steel, Tyres and even disused oil platforms. Over the last 20 years customised modular systems have been designed and incorporated into the marine environment with great success. In the Maldives Many small ships have been sunk specifically for the creation of new reefs to attract fish, coral & divers.



COLONISATION:

Algae and invertebrates normally colonise new reef material rapidly; the final concentration of benthic organisms will depend mostly on water Temperature and current born nutrients.
One reason why planning & sighting of new structures is very important

Fish too colonise these new reefs quite quickly, and biologists classify them according to their orientation and proximity to the reef.
a) Those that contact the reef, residing in crevices or holes.
b) Those fish that are linked to the reef through sound & vision.
c) The fish that tend to hover above the reef alone or in schools.

Fish are attracted to artificial reefs by a variety of factors such as sound, touch and pressure, and visual cues such as shape, size, colour and shadows, but most importantly obvious currents. Again, specific constructions are attracting specific species.

Artificial reefs are now proven to
a) Increase fish aggregation, production, diversity and improved spawning substrate.
b) Give additional recreational facility and interest.
c) Encourage repopulating of degraded areas quickly.

IMPLEMENTATION

We are all aware of the plight of the diving paradise the Maldives, but are we aware of the work that has been going on out there to help protect and enhance the coastline, south of the capital Male maybe not. As the majority of Maldivian atolls reach only 1.5M above sea level they are potentially at risk from the effects of global warming and rising sea levels.
During the 1980's $14 million was spent to provide protection to 1.5 km of exposed and eroding coastline with detached breakwaters, made up of 3 tonne tetra pod armouring units. This project served two purposes: The civil engineering gave the initial impetus for recovery by protecting the coastline from further bombardment, but it also added an extra reef too. As the natural processes take over the new reef now colonised by coral species will hopefully grow with the rising waters. It is already home to countless invertebrates and fish.

To the Northwest of Male is a submerged annular reef called Galu Falhu that had been quarried extensively by the locals for coral and sand for building purposes. The reef was all but dead and showing no signs of recovery naturally, and was chosen as a study site. With the assistance of the Ministry for public works four sets of artificial reef structures were taken out to the reef by barge and lowered by an adapted JCB, being precisely positioned by divers. The four sets had a combined weight of 360 tonnes and were of varying topographic diversity, stability and cost.

Their effectiveness was measured against two natural variables of the same area, one pristine and one quarried out section of reef. During this monitoring study the effectiveness of coral transplantation took place to test if the method would help speed up rehabilitation, the corals being carefully chipped away from their original site, then taken underwater to their new home and fixed to the structures with marine cement. Systematic monitoring of the corals followed in order to gain an insight into the adaptation and practicality for future sites.

Almost immediately after placement of the structures the fish density increased, within a month the numbers had increased by 5X. The sites with transplanted corals appeared the most effective at attracting fish; the less topographic of the components showed a marked but slower increase in comparison. Within 6 months Acropora and other branching corals began to colonise the structure. Within a year of monitoring the sites a noticeable comparison was obvious at the pristine reef and the artificial structures with new growth and diversity, with an increase in the numbers of resident fish & invertebrates. However, the quarried out section of reef remained barren.

Visiting schools of inter-reef fish increased around the structures especially during the rougher weather proving that these artificial reefs were acceptable shelters.

Sometimes as well constructed from concrete blocks or acres of old cars, artificial reefs can be found from cold, rough waters to warm, tropical lagoons. While some artificial reefs might benefit some species of reef fish, they can help as well the tourism of Thailand to recover imidiatly after the tsunami desaster.

Since February 2005, TDA had the idea to promote, organize and to be involved in an intensive program of artificial reef construction and biological monitoring. The purpose is to create a network of artificial reefs in the andaman waters along the southern west coast to provide a hard substrate for fish, shellfish and crustaceans, fishing grounds for anglers, and underwater structures for scuba divers.

Artificial reefs are constructed by intentionally placing dense materials, such as old ships and barges, concrete ballasted tire units, concrete and steel demolition debris and dredge rock on the sea floor within designated reef sites.

With a very limited budget, the TDA Reef Program has depended upon donation from anglers, divers, clubs and marine businesses, maybe as well from the gouvernment to cover the costs of cleaning and preparing ships and other materials for sinking on reefs. Incause of this TDA would like to work very close with Thailands Royal Navy and other enviromental or tourist agencies.

Perhaps the most unexpected advantage of shipwrecks that act as hosts for corals, is that they can ease human pressure on natural reefs.

The presence of artificial reefs as an alternative dive site can reduce the stress placed on the natural reefs. In many cases, artificial reefs will decrease the total dives on natural reefs."

With time, the shipwreck becomes part of the natural environment.

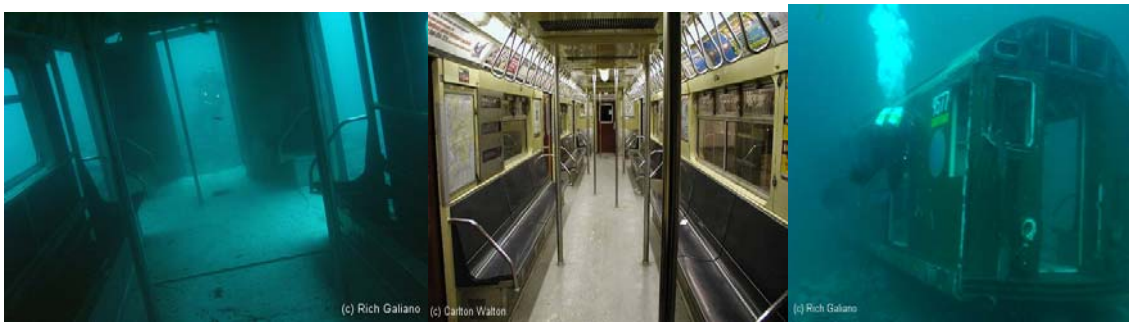
Shipwrecks may have redeeming ecological value. The ships often become artificial reefs and habitats, providing shelter for the very creatures threatened by humanitys original intrusion.

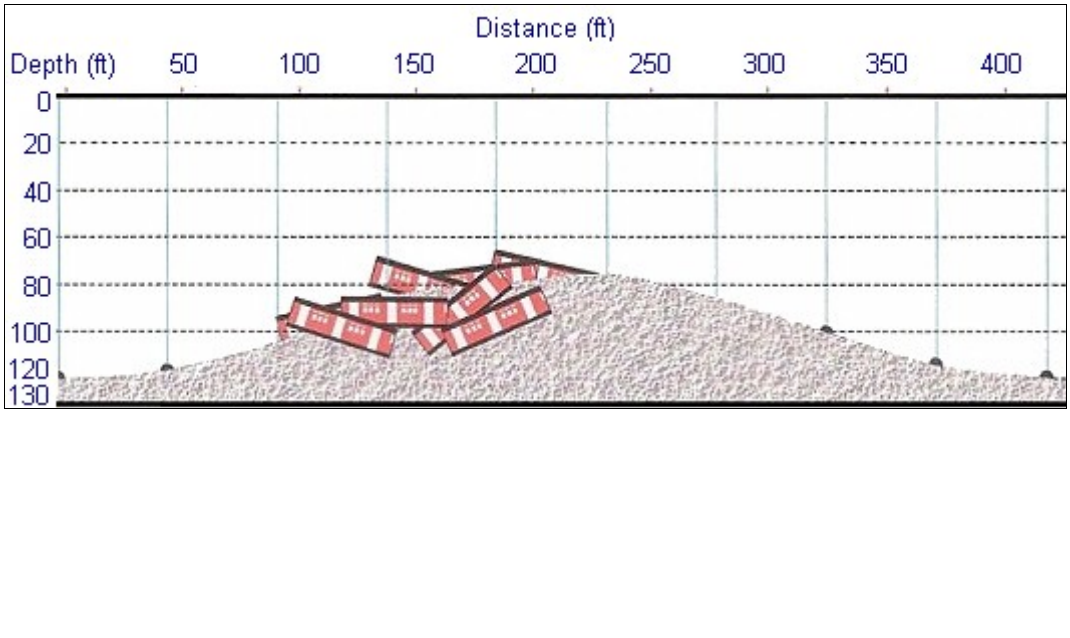
Researchers have found several shipwrecks have become thriving coral communities. These artificial reefs attract divers, easing human pressure on natural reefs.

When a ship sinks, it immediately becomes shelter for marine organisms. Such habitats provide new food sources, greater protection for juveniles, and more space for settlement.

Space is at a premium in a coral reef environment. The new habitat is utilized by fish very quickly. Coral, which is composed of small and delicate polyps, develops more slowly, covering a shipwreck's surface over a period of many years.

Artificial Reef Samples:



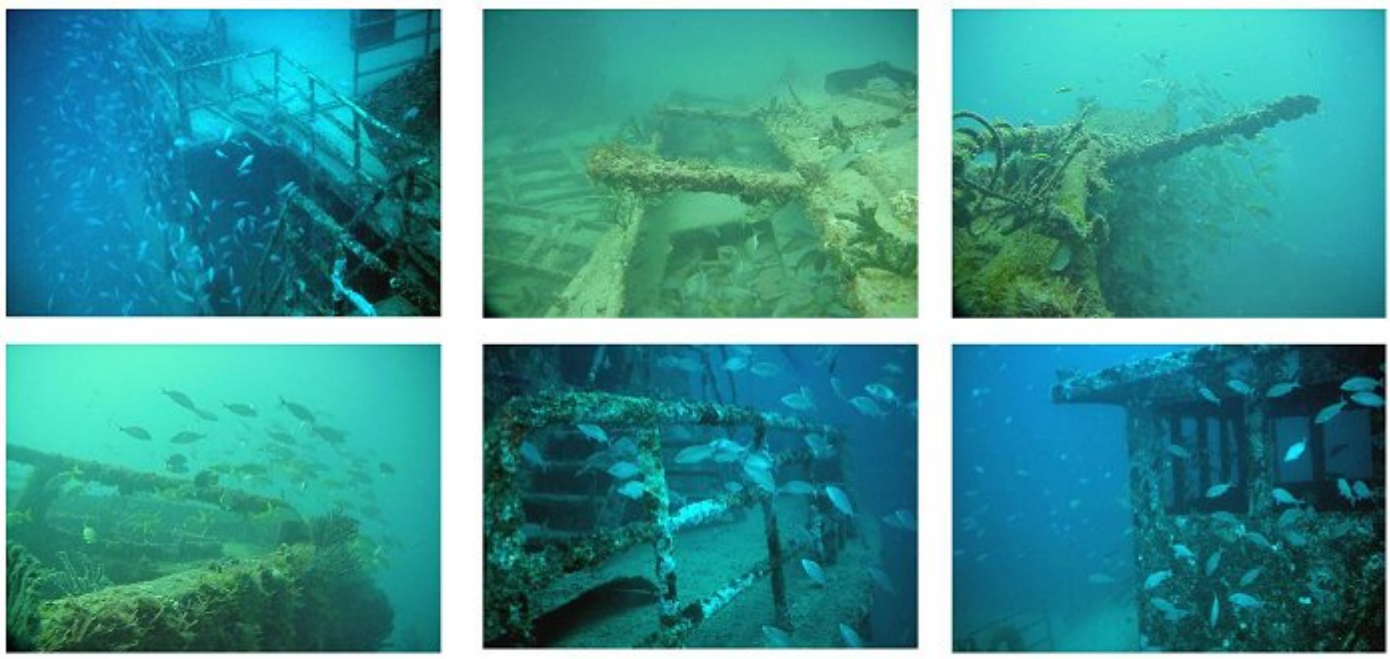


What are the differences between a coral community that develops on a shipwreck and a natural reef?

Orientation of space may play a role in determining what kind of corals and how fast they grow on horizontal or vertical features.

Most shipwrecks, especially those with intact masts, represent vertical structures that attract soft corals, such as the colorful *dendronphya* and *scleronephthya,* which add attractive framework to many reefs in the oceans.

Artificial Reef Samples:



Examples of several of the artificial reefs and their associated fish assemblages.

Artificial reefs have higher fish abundance and mean species richness, as well as assemblages containing species exclusive to the artificial reefs. The appearance of many fish species on the artificial reefs apparently absent from nearby natural reefs may indicate the ships provide some structural or chemical attribute which is lacking on the natural reef. Furthermore, the presence of species on ships not seen on nearby natural reefs may be an indication of local production on the artificial reefs.

Ships made of wood provide a different hosting environment than those built of steel. Steel is a very successful choice of reef as wood decays. Steel structures are also covered fast by calcareous algae, which provide an adequate surface for coral larvae to grow quickly.

Absolute Similarity

With time, there is an absolute similarity between natural and artificial habitats.

Another advantage of artificial reefs is that they can enhance the development of rare coral species that are not often found in natural reefs.

The Andaman Sea is a paradise for discovering new species. It is one of the richest reef habitats in the world, in terms of density and diversity of species.

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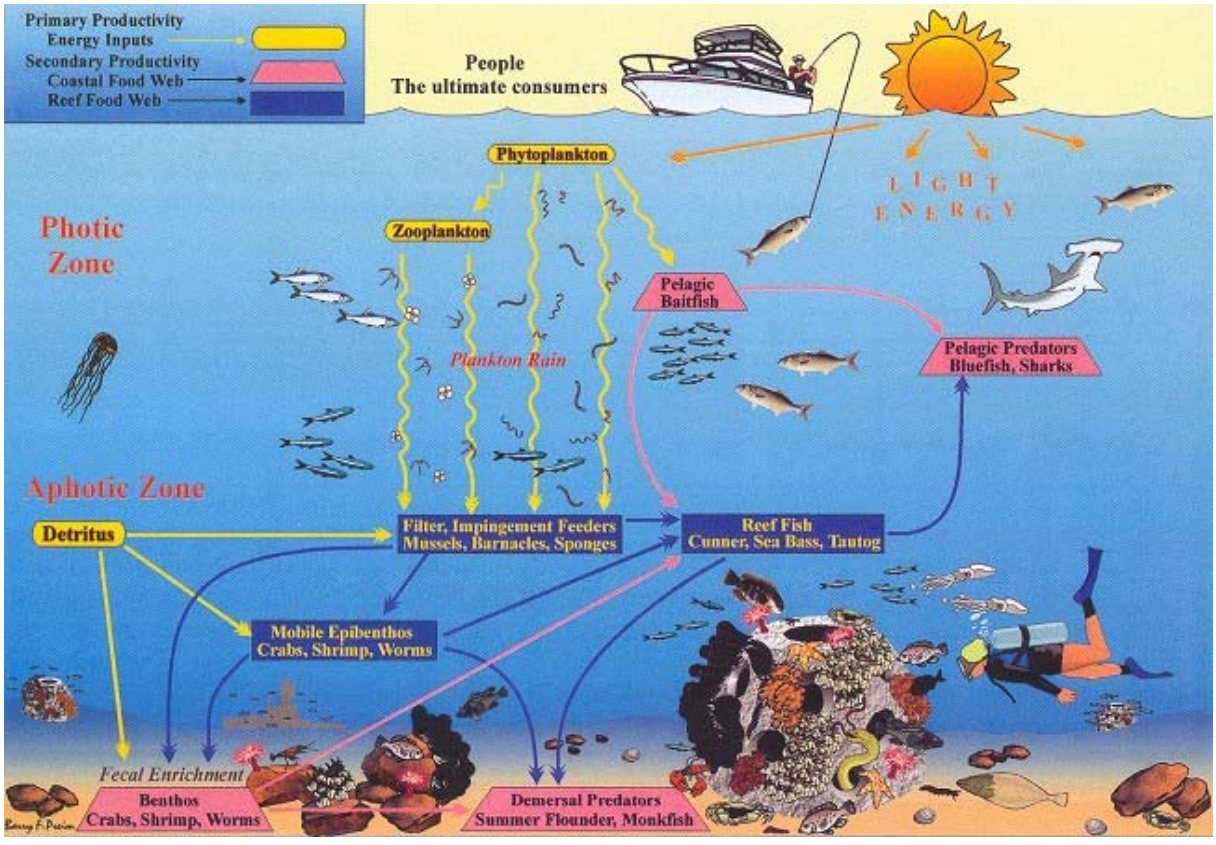
The presence of artificial reefs as an alternative dive site can reduce the stress placed on the natural reefs, in many cases, artificial reefs will decrease the total dives on natural reefs.



Everyone benefits from artificial reefs

When it comes to food, most fish and other marine life are very opportunistic- they eat what is available at the time and suitable to their feeding approach (mouth size,

teeth, etc.) Big things eat smaller things and, since almost all marine species begin life as microscopic larvae, few are spared the gauntlet of hungry adversaries that come in every form and size and must likewise eat to grow bigger. In nature, it's eat or be eaten.

The rate of attrition is horrific, almost complete. Only the rarest individual, through a combination of adaptation and luck - mostly luck - survives from larva to adult. For each survivor, countless others must perish, consumed.

The man-made reefs along the Thailand coast, eventualy constructed of rock, concrete, ships, and other structures, will be colonized by their own special, thriving marine life communities. The healthy biota concentrated on, in, around, and over these hard-substrate habitats have a healthy appetite, too - an appetite that we are only beginning to understand.

In the andaman sea, plants using energy derived from sunlight convert carbon dioxide gas, water, and nutrients into living tissue. Plants are called producers since they make their own food. The rate at which they do this is called primary productivity. Producers comprise the basic building blocks of the marine food web. The ocean waters off the andaman sea are nutrient-rich and very productive. The andaman sea gets its color from countless millions of microscopic plants (phytoplankton) that thrive in the upper, lighted portion of the water column called the photic zone.

Phytoplankton provide food for zooplankton (microscopic drifting animals) and the larval forms of other marine animals, such as fish and crabs, that grow much larger as adults. Unlike plants, all animals must obtain their food through consumption and are thus called consumers. Animals feeding directly on plants are classified as primary consumers.

As this drifting, planktonic community of microscopic plants and animals is carried along by currents, it is also slowly sinking, eventually reaching the depths where reefs are found. At these depths - 50 to 125 ft - not enough sunlight may penetrate the water column to support photosynthesis. Thus, few plants can live and grow there and, as a result, very little primary productivity occurs on New Jersey reefs. Instead, these deepwater environments are colonized by marine animals - consumers.

The Consumers

The initial input of energy (food) into the reef food web comes from two outside sources: phytoplankton drifting or carried by currents down from photic, surface waters and detritus, which is composed of fine particles of decayed plant and other organic matter that washes from land out to sea. These two sources of energy, both derived from the primary productivity of photosynthesis, are captured by primary consumers on the reef - the filter-feeding animals that live attached to the reef structures.

These animals are known as fouling or encrusting growth or, scientifically, as epibenthos; they include blue mussels, barnacles, bryozoans, and sponges. These animals siphon seawater through their gills or guts, straining out plankton and microscopic food particles. They often carpet reef structures in dense colonies; for example, some surfaces support as many as 10,000 young mussels per square foot.

Other epibenthic organisms that also live attached to reef structures capture zooplankton and drifting larvae using small stinging cells. These animals are known as impingement feeders and include anemones, hydroids, and stony coral. Even the initial larval stages of higher forms of life, including fish, fall prey in vast numbers to the living, feeding carpet of epihenthos. Fouling organisms form the base of the reef food web, because they harness energy from the plankton in the water column, have a great collective biomass (weight of organisms) and become a source of food for higher level consumers.

Once a fouling community is established on a shipwreck or other reef structure, a host of mobile invertebrates crawls in to dine on mussels and barnacles, which are anchored in place, unable to escape, their shells providing their only defense. Predators use an array of techniques to overcome the protective shells. Starfish employ hundreds of suction feet and hydraulic arms to pry open mussel shells - water pressure never tires; muscle tissue does. Jonah crabs and lobsters use powerful claws to crush the shells. Tautog, Cunner, and Triggerfish have teeth designed for nipping off mussels, which are then swallowed whole.

Other sessile invertebrates are under attack as well. Sea Urchins crawl slowly over the reef, methodically grazing on minute, invertebrate growth. Shrimp pick away at the soft, bulbous bodies of anemones. Animals that feed on primary consumers are termed secondary consumers. The carnage is so great that reef surfaces supporting dense colonies of mussels and barnacles in the spring are often cleaned bare by the fall. Only those fortunate enough to have settled in a tight crevice manage to survive. However, maintaining their status as the foundation of the reef food web, fouling organisms are prolific, and denuded reef surfaces are re-colonized annually.

Even waste products do not go to waste. The fecal matter expelled by the dense populations of the fouling community enriches the sea floor around the periphery of the reef. The fecal matter is reprocessed by filter- and deposit-feeding animals, called benthos, that live buried in the sand. These animals include tube worms, sand shrimp, nematodes, crabs, and sand dollars. Many of them thrive on the natural fertilizer shed by the reef community.

The Eaters Become the Eaten

All kinds of Reef fish - Sea Bass, Tautog, Cunner, Scup and Triggerfish - forage on and off the reef. Mobile, epibenthic invertebrates living on the reef and the surrounding sand bottom - crabs, shrimps, amphipods, isopods, worms, and snails - are prime food items for reef fish. For example, crabs account for about 85 percent of the diet of Sea Bass. Some are captured around the reef; others are rooted out of the sand. The fish feeding on crabs are considered tertiary consumers. Being opportunists, Sea Bass will also attack schools of bait, such as Butterfish, Anchovies, or squid, that congregate around or swim by reefs.

Young-of-year fish, only an inch or two in length, that live on the reef are also subject to predation from other reef fish, such as Sea Raven and Murray Eel. Secluded hiding places within the structures may improve these fragile youngsters' chances of survival.

Wherever communities of marine life are concentrated, larger ocean predators will also congregate in hopes of finding an easy lunch. These predators follow either of two routes to the reef, over the sandy sea floor or through the water column. Those on the sea floor, called demersal predators, rely on stealth and camouflage to ambush unsuspecting reef denizens. Fluke, Stingrays and Monkfish, for example, are flattened fishes with skin that can alter its coloration to mimic the pebbles, shell fragments, and sand of the surrounding bottom, allowing these predators to practically disappear. They lie patiently in wait around the edges of reef structures and only strike when their unsuspecting victim approaches too closely for escape.

Those that visit from higher up in the water column are called pelagic predators. These constantly swimming predators, which include Bluefish, Striped Bass, Tuna, and sharks, rely on speed and agility to dart ahead and out-run their prey. The presence of reef structures makes this task a lot harder, and a relatively slow reef fish, which would otherwise he an easy target in the open water, becomes almost impossible to catch where reef hiding places abound. These off-reef marauders, when feeding on fish, represent fourth-level consumers.

Each link in the food chain is called a trophic level. The trophic level assigned an animal depends upon the trophic levels of the food items it eats. Plants (phytoplankton) occupy trophic level 1; all the higher levels consist of animals. In the marine food web, most species feed upon a variety of items and, consequently, may fit in more than one trophic level.

With rare exceptions, people are at the top of any food chain and the reef food web is no exception. In 2000, recreational anglers caught 4.8 million fish of 25 species on US artificial reefs. Comerial Scuba divers in North America harvested 17,000 lobsters and 32 tons of mussels. These diverse seafood choices put humans in trophic levels 3 through 7 in relation to the marine reef food.

The TDA Diving Association (Thailand) wish is to get support and permit to accept the artificial reef project and creation of dive sites in the andaman sea.

TDA”s Artificial Reef Project from its inception has been regarded as presenting significant tourism, economic and industry development opportunities for the Andaman Coast and the Kingdom of Thailand. The Thai Royal Navy should be the lead agency responsible for the project and the long-term management should be

done according the ideas and sucesfull samples from other countrys artificial reef projects.

Sinking ships off Thailands southern andaman coast as an artificial reef park will provide great recreational opportunities for scuba divers. Shipwrecks are popular locations for recreational divers wanting to explore both the vessel and marine life attracted to it. As new reef communities develop, it is hoped these wrecks will become a centrepiece for dive tourism in southern Thailand. The TDA"s Artificial Reef will be managed for this purpose. The TDA's goal is to create Thailand's premier artificial reef and dive site. This will be achieved through the following strategies:

- making the ships physically and environmentally safe;
- declaring a Marine Park (if not yet declared) over the artificial reef site to allow ecological sustainable use and management; linking business and tourism opportunities on the southern andaman coast and assisting development of marketing strategies;
- regulating use of the reef sites by commercial operators and affiliated dive clubs (members of TDA, TAT a.s.o.) to provide adequate and safe public access;
- managing the site as a self-sustaining venture through the introduction of user fees;
- improving recreational and conservation values of the area by prohibiting fishing and assisting the development of new reef communities;
- developing partnerships with the community, commercial operators and other state agencies to manage and conserve the site;
- installing moorings to provide safe anchorage and protect conservation values; and
- providing promotional and public education opportunities to encourage enjoyment and understanding of the TDA`s Artificial Reef Project.

Marine Park

A management plan for the site (under the Thailands Marine Parks) will regulate public access, ensure public safety, and conserve its natural and cultural values to maintain it as a quality centrepiece for dive tourism in Thailand. Every single "WRECK" is proposed a small marine park will be declared over the artificial reef site, or ALL wrecks together can be a great and huge marine park.

Visitor access, use and enjoyment

Shipwrecks are popular locations for recreational diving. Similar artificial reefs throughout Thailand attract in excess of 10,000 divers each year. TDA estimates the Artificial Reef Project could attract up to 75,000 divers each year because of its proximity to the southern andaman coast, a popular tourist destination, and the area's sub tropical climate.

Maintaining the quality of the diver's experience at the different wreck sites depends on conservation of the natural and cultural values of the artificial reef and restricting diver numbers to suitable levels. The number of divers will be based on:

- tourism and economic opportunities;
- expectations of commercial and recreational divers;
- maintaining the diver's experience and amenity ; and
- minimising impacts on the natural and cultural values of the artificial reef.

Visitor safety

Wreck diving is challenging and adventurous for recreational divers, but also has potential risks. These include entrapment, getting lost, injury from sharp protrusions, entanglement in discarded fishing line and decompression sickness (bends). The TDA aims to minimise risks to divers by managing conflicting activities, ensuring safe diving practices, removing hazardous material and protrusions and minimising risk of entrapment. The Wrecks must be sunk at deep and as well at shallow dephts for experienced and unexperienced tourist divers.

Environmental management

The ships will be cleaned of all hazardous material prior to sinking. Contaminants include: tributal tin, carbon deposits, lead and hydrocarbons. These materials will be removed according to correct regulated waste disposal methods.

Sinking the ships is likely to have minimal impact on the existing environment. If sunk on sand, the impacts of directly smothering seabed communities would be minimal. The artificial reefs created by the ships is expected to attract existing fish communities from adjacent natural reefs, even if destroyed by the Tsunami.

Historical significance

The ships are prepared to maximise its quality as a diving experience. Preparations will ensure that the 'dignity' of the ships are maintained. Removal of items of interest will be minimised.

Management

Detailed planning will be undertaken before finalising day-to-day management of the TDA"s Artificial Reef Project that will include: visitor management and commercial activity administration, surveillance and compliance, communication and community engagement, risk assessment and mitigation, environmental assessment and monitoring, installation and maintenance of moorings and navigational aids. Consultation with the community, universities and commercial operators will be undertaken as part of management planning.

If the Thai Government does not want the development and ongoing management of the TDA Artificial Reef Project to be an additional cost for the Country, TDA help to promote the Project in advance to find enough sponsorship to realise the project. As such, fee arrangements will be in place ensure management of the site is self-sustaining.

The Royal Navy of Thailand endorses the TDA artificial reef project