SDNP - ENVIS NEWSLETTER

Estuaries, Mangroves, Coral Reefs and Lagoons

Sponsored by
Ministry of Environment and Forests, Government of India, New Delhi

http://casmbenvis.nic.in Vol.1: 2006

Editorial

Hello Readers,

The ENVIS (Environmental Information System) newsletter on estuaries, mangroves, coral reefs and lagoons has come in different dimensions over the period of time covering various facets of the coastal and marine ecosystems. That way is plays an important role in the dissemination of information to the scientific community. Recently the Ministry of Environment & Forests has selected our Centre as one among the 20 SDNP (Sustainable Development Networking Programme) Networking Systems to strengthen the existing ENVIS Centre in the field of Marine Ecosystems. Through the SDNP networking system, the ENVIS Centre has been bringing out special newsletters.

This issue carries three important articles. The first article indicates clearly the various policy and management practices followed for conserving and managing mangrove ecosystem in Thailand. Following this is an article which briefs the phyto-biogenic interactions in coastal dune of northeast India. The third article explains the potential applications of the nano-tools in medicine. This issue also carries recent news in the field of research besides forthcoming scientific meets. Apart from reading, the users can contribute articles to our ENVIS newsletter.

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SUSTAINABLE DEVELOPMENT NETWORKING PROGRAMME (SDNP) OF ENVIS

Sustainable development

Sustainable Development is "development which meets the needs of the present generation without compromising the ability of future generations to meet their needs" (Brundland Report, 1987).

Sustainable Development Networking Programme (SDNP)

Sustainable Development Networking Programme (SDNP) is a small grant programme of ENVIS of Indian – Canada Environment Facility (ICEF), New Delhi. to strengthen the activities of the centre. It was initiated after the receipt of first installment of grant in November 2005 as a part of ENVIS program.

SDNP project

This project executed by the Ministry of Environment and Forests (EI Division) is coordinated by the Institute for Ocean Management, Anna University, Chennai. The ENVIS – SDNP has started functioning from June 2005 and the participating ENVIS centres are updating and constructing the web for effective communication process on sustainable development.

The objectives of the project are to develop a SDNP website and support the Sustainable Development of the resources by integrating the resources available in the existing ENVIS center network. With about 20 thematic areas, the involving centers were identified as SDNP partners. Bi-annual E-newsletters are being published to integrate the themes, which can provide and support the sustainable management planning. The most direct beneficiaries of ENVIS Network on Sustainable Development will be the information users involved in the sustainable development process.

Scope of the SDNP

Exchange of information for sustainable development is one among the commitments of all signatories of Earth Summit (Agenda 21, Chapter 40). The sustainable Development Network Program (SDNP) is an essential tool for better decision-making at all levels. SDNP have the following objectives:

1. participation or involvement of all segments of the society, community, organization and institutions.
2. self financing capacity to run the SDNP other than inception fund.
3. use of existing information networks to strengthen the knowledge base.
4. include and integrate environmental protection and human welfare for all developmental planning.
5. meta-tagging and developing national nodal database
6. capacity building for SDNP
7. implementation of national commitments to UN including Agenda 21, World Summit on Sustainable Development (WSSD) and Millennium Development Goal (MDG) and

8. use of appropriate technology for coordination, dialogue and decision making. In total SDNP is more than an information network, which has the capacity to foster informed dialogue and communications to encourage and empower stakeholders, who are most influenced and focused by it.

SDNP – Activities

- Recognizes Sustainable Development Network Partners in premier institutions / organizations across the country on 15 thematic areas already identified under UNDP programme.
- To develop new thematic areas (5) and also establish Sustainable Development Network Partner on these thematic areas.
- Networking 11 ENVIS Nodes identified on spatial platforms using spatial technologies.
- Provide support to 13 ENVIS Nodes for creating databases and putting them online.
- Prepare a report on similar global scientific networks including Indian.
- Publish annual ENVIS Newsletter on subject specific ENVIS Nodes and activities and .
- Prepare a report on the Sustainable Development Network.

ENVIS

The Environmental Information System (ENVIS) Centre at the Centre of Advanced Study in Marine Biology, Annamalai University has been successfully functioning and offering its services to the scientific community continuously since its inception in March 1992. It has completed more than a decade of operation in the field of sensitive and fragile coastal and marine ecosystems. The Centre collects, collates, retrieves and disseminates information on its major subject areas *viz*. Estuaries, Mangroves, Coral Reefs and Lagoons as assigned by the Ministry of Environment and Forests. The Centre has voluminous literature collection pertaining to national and international scenarios and developed textual and electronic database to serve the users.

Objectives

- To establish databases on estuaries, mangroves, coral reefs and lagoons
- To identify data gaps and bridge the gaps
- To establish online access for available data
- To respond National and International queries
- To bring up good collection of books, reports, journals etc.
- To bring out in-house newsletter
- To disseminate information to user community through abstract retrieval system and reprints supply
- To adapt information technologies at the advanced level

MANGROVES OF THAILAND: POLICY AND MANAGEMENT PRACTICES

The mangroves in Thailand which cover about 50% of the 2,670 km stretch of coastline, play an important role in economy of the country. The mangrove forests provide timber, fuel-wood, poles, and wood for charcoal making, thatching materials, medicines and food.

The total extent of mangrove forest in Thailand is about 2,441.6 sq. km. About 86% of the forests are in the southern region, 9% in eastern part and 5% in central part of the country (Fig. 1). The best mangrove formations with large and dense trees are present along the coastline of the Andaman Sea while the mangrove forest along the coastaline of the Gulf of Thailand exists only as a narrow strip due to the destructive activities of Man. The largest mangrove forest covering an area of 454.6 sq.km is in Phangnga Province which alone constitutes 18.6% of total mangrove area. The dominant species of mangroves in the country are *Rhizophora apiculata*, *R. mucronata*, *Sonneratia* spp. and *Bruguiera* spp. The mangrove forest in Krabi is the Ramsar Site that alone has 25 species of mangroves, besides 143 species of phytoplankton, 14 species of molluscs, 15 species of crabs, 35 species of shrimps, 232 species of fish, 221 species of birds, 29 species of terrestrial reptiles, and 8 species of amphibians.

Unfortunately, the mangrove forests in Thailand are being destroyed or degraded at an alarming rate with degradation taking place in more than 50% of the total area in a 35-year period. In other words, the forest area declined

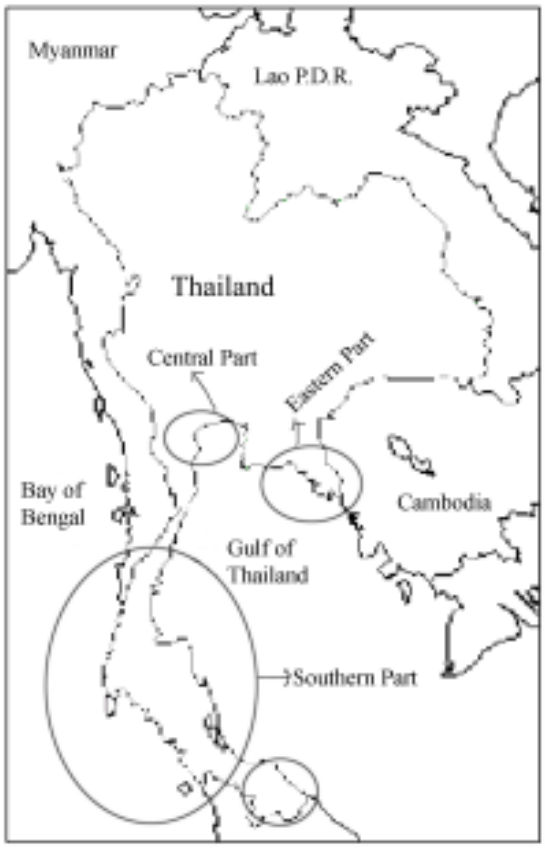

Fig.1. Map of Thailand showing mangrove areas in circles

from 3,679 sq. km in l961 to 1,676 sq. km in l996. The rate of mangrove disappearance between 1961 and 1993 was at 62.25 sq. km/yr and the rate was highest at about 129.86 sq. km/yr during 1979-1986. The mangrove forest was cleared mainly for shrimp pond construction and the area converted was up to 749.42 sq. km between l987 and l995. Besides, mangrove areas were reclaimed for several other purposes such as agriculture, urbanization, salt production and constructions of road. Dredging in ports and harbours and mining for tin also contribute to loss of mangrove. Mangroves suffered destruction

beyond the limits of their natural ability to regenerate. This caused rapid loss and damage to Thailand's mangroves. However, most mining concessions have now expired. Realizing the situation, the Government of Thailand has formulated national policy and management practices in order to achieve the sustainable management and conservation of mangroves in the country. This paper discusses them in detail.

1. Stopping of concession for clearing mangroves

The size of majority of the existing mangrove forests is small with low biodiversity. Originally these had larger area with higher number of species including *Rhizophora* spp., *Bruguiera* spp., *Avicennia* spp., *Sonneratia* spp., *Ceriops tagal*, *Xylocarpus* spp., *Lumnitzera* spp. and *Kandelia candel*. This situation is due to mangrove tree logging concessions given by the Government. The first such concession was issued in 1966 and in the first 15 year period, as many as 310 concessions were issued for felling trees over an area of 1,769.49 sq. km. However from l996, all the mangrove cutting concessions have been suspended.

2. Creation of mangrove zones

Mangrove zonation is an important step undertaken towards controlled and sustainable utilization of mangroves. The Government of Thailand divided the mangrove forest area into 2 zones – (i) Conservation Zone (426 sq. km or 11.46% of total mangrove area) and (ii) Development zone (3,296 sq. km). This development zone is further divided into two sub-zones namely (a) Economic Zone-A (1,996 sq. km - 53.61% of total) and (b) Economic Zone-B (1,300 sq. km - 34.93% of total).

2.1. Conservation zone: This includes all the existing mangrove forests, placed under protection and preservation in their natural conditions. Any disturbance or utilization activity in this zone is totally prohibited. The conservation zone includes the following:

a) Areas to preserve economic plants and animals

b) Nursery grounds for plants and animals

c) Areas susceptible to damage and erosion

d) Historic areas

e) Areas with local uniqueness

f) National parks, tourist areas, wildlife sanctuaries, non-hunting areas

g) Wind shield areas

h) Areas significant for research

i) Areas significant for environmental and ecological preservation and

j) Areas more than 20 meters from natural rivers or streams, or more than 70 meters from the sea coast

The Government has also given the following guidelines for the land use in this conservation zone:

- Wherever the forest has been damaged, reforestation should be undertaken by the government agencies concerned.
- Newly formed areas within this zone are deemed to be the property of Government and plantation should be made in those areas immediately.

- Government agencies should control people's encroachment on the mangrove land within the zone.
- The validity of permits for logging concession, shrimp farming, tin mining or other activities must not be extended when their concessions terminate and
- In the case of implementation of projects of high economic importance or national security within this zone, the government agencies should submit their proposals with Environmental Impact Assessment to the Government for approval.

2.2. Development zone: Areas where conversion of mangrove area is there for development is called as development zone. The guidelines for land utilization in this zone are the following:

- Government agencies are empowered to rehabilitate any degraded mangrove area of this zone.
- Government agencies are obliged to prohibit any formerly illegal development activities and replace the areas with mangroves.
- All laws and regulations should be revised for reforestation in this zone.
- Use of mangrove land for fisheries, tin mining, cultivation and other developmental activities must be strictly controlled for conservation and
- Any activity prior to its commencement must be carefully considered for its effects on the mangrove ecosystem.

2.2.1. Economic zone-A: In this zone, only sustainable uses of mangroves are permitted which include

a) Concession areas

b) Community forests and

c) Mangrove plantations

2.2.2. Economic zone-B: This zone includes degraded mangrove areas in which other land uses and developments are allowed with due consideration to the environment and this zone includes

a) Areas used for agriculture (crops, husbandry, fisheries, salt farms)

b) Industrial area (mining, factories)

c) Urban areas

d) Trading and commercial areas

e) Piers and harbors and

f) Others

3. Policy and management practices for mangrove plantation

In order to increase mangrove area of the country, the mangrove plantation has been made in new mudflats, degraded forests, abandoned mining areas and abandoned shrimp ponds since 1960. Two major species that are used for the plantation are *Rhizophora apiculata* and *R. mucronata* besides other species such as *Ceriops* spp. and *Bruguiera* spp. The spacing maintained in the plantation is 1.5 x 1.5 m. The new mudflats and/or degraded mangrove forests are successfully reforested with *Rhizophora apiculata* and *R. mucronata*, abandoned shrimp

ponds with *R . apiculata* and *Bruguiera cylindrica*, and abandoned tin mining areas with *Avicennia officinalis* and *Ceriops tagal*.

During 1991–1996, the government planted mangroves annually over an area of 320 Sq. km. Also, the private sector, local communities and students participated in the government programmes and were able to plant mangroves annually over an area of 480 sq. km during 1994-1999. However, these efforts are still low and are unable to substitute the mangrove areas which have already been damaged. The cutting rotation applied for private plantation is fixed as 10 years for firewood collection and charcoal burning. However, the government plantation is yet to come out with plan for harvesting.

4. Silviculture practices for managing the natural forests

The silviculture system followed in Thailand is successful. This system involves clear felling in alternate strips. Rotation is set at 30 years with a felling cycle of 15 years. This is practiced by dividing the area into 15 strips every 15 years, thus giving a rotation of 30 years. Seedlings and saplings of the mangroves are left undisturbed in the strips. In situations where sufficient regeneration can not be obtained, enrichment planting is also carried out.

5. Efforts for mangrove seed/seedling production

In order to supply the seeds for planting by public, the government has set up four mangrove seedling production centers in Trad and Phangnga Province in 1992 and Nakhon Si Thammarat and Satun Provinces in 1993. Many more such centers are required for large scale production of seeds.

6. Policy and management practices for community participation in mangrove rehabilitation

The community participation includes seven aspects (i) creation of strong and powerful community organizations, (ii) establishment of network among community organizations, (iii) strengthening of relationships between governmental agencies and community organizations, (iv) promotion of integrated conservation management systems between mangroves and aquaculture, (v) training programmes for communities in conservation and rehabilitation of mangroves forests, (vi) promotion of woman society in mangrove conservation and rehabilitation programmes and (vii) promotion of fundamental research needs on community participation. To start with, a mangrove village has been selected at Khlong Yang Sub-district, Koh Lanta District, Krabi Province.

The government has promulgated a Decentralization Plan and Process Act, 1999 under Article 284 of Constitution 1997 under which the local organizations like municipalities have their rights/power in organizing public services for local people, which can be classified into two main categories: (i) social infrastructure development and (ii) quality of life development.

7. Policy and management practices for aquaculture development in mangrove areas

In Thailand, the mangrove areas are mostly cleared for aquaculture of tiger shrimp

(*Penaeus monodon*) especially in southeastern coasts of the Gulf of Thailand. Other species such as *P. merguensis* and *P. indicus* are also cultured in limited areas in the upper Gulf of Thailand. To manage sustainable shrimp culture and to protect mangroves from expansion of shrimp farming, the following guidelines are given:

- Shrimp farming should be practiced behind the mangrove forests with a proportion of at least 5:1 between mangroves and shrimp pond.
- Large scale shrimp farming should be approved on the basis of EIA.
- Shrimp farmers should maintain the mangrove resources and coastal environmental quality.
- Only suitable sites for aquaculture will be utilized based on their physical, chemical, geographical and biological conditions in mangrove areas and
- Integrated management between aquaculture and mangrove forests should be promoted.

8. Policy for mangrove research

Mangrove research focuses on (i) self-subsistence on mangrove resources, (ii) increasing productivity and value added benefits of mangrove resources, (iii) good participation of public and local communities in mangrove conservation, and (iv) identification of potential mangrove resources.

Royal Forest Department has established two mangrove research centers. One is in Trang province and another one is in Ranong province. This Ranong province has become the UNESCO Biosphere Reserve since l997 and the center here provides facilities to scientists from different parts of the world towards implementation of cooperative research activities and it offers training programmes on mangrove ecosystem and sustainable resource utilization to the government operators and public. It is necessary to establish similar mangrove research centers in every important coastal ecosystem.

9. Declaration of Marine Protected Areas (MPA) for conservation

There are 21 MPAs covering 5,810.23 sq. km (1.13 % of the country). Six more areas have been proposed for MPA and 4 MPAs for recognition as the World Heritage sites of UNESCO and these are Tarutao, Surin, Similan and Ao Phangnga Marine National Park. One site is proposed as a Ramsar Site and it is Khao Sam Roi Yot Marine National Park.

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PHYTO-BIOGENIC INTERACTION IN COASTAL DUNE FIELD OF NORTHEAST INDIA

Introduction

Coastal dunes are quite distinct from all other coastal landforms as they are formed by wind, rather than water movement and differ in morphology from desert dunes eventhough the basic principle of sand movement is the same in both areas (Pethick, 1996). They are generally products of interaction between sand transport by wind and growth of vegetation. The coastal dunes are also important to the ecologists as they offer an ecosystem with a characteristic morphology and habitats for both plants and animals. Dunes are less conspicuous in the muddy coastal zone of the Sundarban Biosphere Reserve (SBR), where luxuriant mangrove vegetation, numerous tidal inlets and creeks, low wind velocity and moist to wet sediment baffle their formation.

In contrast, in the coast zone of West Bengal and Orissa outside the SBR where mangroves are not there, particularly along the landward extension of the sandy beaches, the dunes are well-built structures bordering the high-tide mark. The dune height ranges from 1 to 3 m at Gangasagar and Beguakhali beaches, but goes up to 10 m in the Digha-Talsari Coast. These high dune areas are favoured by (i) dominant onshore winds (ii) halophytic vegetation (iii) wide exposure of beaches at low tides and (iv) extensive backshore area (Pethick, 1996). The embryonic dunes of small mound and arculate-shapes (1 to 2 m high) and large undulating fore-dunes are associated with a number of halophytic vegetations. Some of them are creeper grasses and others herbs and shrubs (Table 1). These vegetations have complex root systems which help them to get bound with the dune sands (Bhattacharya *et al*., 1987; Bhattacharya and Jana, 1993).

Role of halophytes in dune generation and degeneration

In almost all cases, the embryonic dunes have anchoring vegetations like *Paspalum vaginatum*, *Ipomoea pes-caprae*, *Salicornia* sp., *Opuntia* sp. and *Launiea* sp. As the dunes get anchored and grow further to be more mature, other forms of plants (Table 1) appear to give a stronger bonding of the dune sands and a surface matting to protect them against stroms. *Sesuvium* sp. has extremely long (up to 3 m) deeply penetrating roots. *Ipomoea* sp. forms a good network of roots, which often penetrate up to a depth of 1 to 2 m.

Table 1. List of important plants in dunes and supratidal flats of the study area

1	**Grass** *Porteresia coarctata* Tateoka *Urochondra setulosa* Hulb *Paspalum vaginatum* L.
2	**Herbs** *Salicornia brachiata* Roxb. *Hibiscus tiliaceus* L. *Heliotropium curassavicum* L. *Suaeda monoica* Forsk. ex. Gmel. *S. maritima* (L) Dumort. *S. nudiflora* Wild *Ipomoea pes-caprae* (L.) Sweet *I. tuba* G. Don *Sesuvium portulacastrum* L. *Stictocardia tillifolia* Hall. *Caesalpinia bonduc* Roxb.
3	**Shrubs** *Acanthus volubilis* Wall. *Acrostichum aureum* L.

The low dune fields periodically undergo submergence during periods of extreme flood. The suspended mud load then settles on the crests and troughs of dunes to form undulating mud layers of variable thicknesses (few cm to 0.5 m). Occasionally, the roots of vegetation are

getting truncated abruptly against the mud layers providing evidence of erosional and unconformable relations of different sand and mud layers within a dune. Both physically deposited sediments and plant root activities in them can produce complex patterns of amalgamation of beds (Dott, 1988).

Mangroves as agent of phytobiogenic interaction

Disturbance of physical laminae by the penetration of vegetation roots is not only the characteristic of sub-aerial beaches, but is also present on intertidal mudflats. Dense stiltroots of the various mangrove species like *Bruguiera sexangula, Avicennia alba, A. officinalis, A. marina, Sonneratia alba, Rhizophora apiculata, Ceriops tagal, Nypa fruticans* etc. (Naskar and Guha Bakshi, 1987) together with their pneumatophores profusely disturb their muddy siliciclastic substratum. Sometimes the lower intertidal mudflats of sheltered regions nurture the growth of mangrove saplings and algal mats. These vegetations also play a significant role in disturbing the physical layering of sediments. The preservation potential of these structures in the backshore environment is generally low, due to its ephemeral nature and the difficulty of burying. On the contrary, disturbance on intertidal muddy substrates by mangrove roots and pneumatophores is much more important to be preserved as phyto-biogenic structures.

Concluding remarks

The deep penetrating roots may aerate the subsurface soil and so the deeper sediments are oxidized leading to brown colouration. Naturally eroded dune sections or cut-out trenches on backshore beach often reveal evidence of subsurface oxidation along the burrows formed by decomposition of root and rootlets. The bonding of deeper riverbank sediments is thereby loosened to a great extent and the deposits are disintegrated with time. Such phyto-biogenic interaction, therefore, also acts as an agent of biological disintegration of coastal dunes.

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NANOTECHNOLOGY AND MEDICINE

Introduction

Every once in a long while, a new field of science and technology emerges that enables the development of a new generation of scientific and technological approaches, and research and clinical tools and devices. Nanotechnology holds such promise. The essence of nanotechnology is the creation and utilization of materials and devices at the level of atoms, molecules, and supramolecular structures, and the exploitation of the unique properties and phenomena of matter at the scale of 1 – 100 nm (a nanometer is $1x10^{-9}$ or 0.000,000,001 of a meter, which means there are one billion nanometers in one meter), in order to understand, create, and use new material structures, devices, and systems with fundamentally new properties and functions resulting from their small structure. The atom, which is the primary constituent of life, exists on this scale, and quantum properties of individual atoms are very different than the bulk properties of the same atoms. Knowledge of these differences is useful when designing new medical treatments and devices that function on the nanoscale.

The investigative methods of nanotechnology have made inroads into uncovering fundamental biological processes, including self-assembly, cellular processes, and systems biology (such as neural systems). Key advances have been made in the ability to make measurements at the sub-cellular level and in understanding the cell as a highly organized, self-repairing, self-replicating, information-rich molecular machine.

Nanotechnology in medicine

The promise of nanoscience for medicine rests on various grand challenges. An important one is connected to our abilities to manipulate the behavior of a “single cell” or groups of cells of common phenotype using synthetic nano-objects that are targeted to interact specifically with the cell’s own functional nano-objects (i.e., receptors, cytoskeleton parts, specific organelle locations, nuclear compartments, etc.). In future this area will allow us to diagnose disease at much earlier stages than we do presently, reverse disease, repair or re-grow human tissues and may be to enhance human performance when needed.

A sample list of areas covered by and converged with nanomedicine includes: Biotechnology, Genomics, Genetic Engineering, Cell Biology, Stem Cells, Cloning, Prosthetics, Cybernetics, Neural Medicine, Dentistry, Cryonics, Veterinary Medicine, Biosensors, Biological Warfare, Cellular Reprogramming, Diagnostics, Drug Delivery, Gene Therapy, Human Enhancement, Imaging Techniques, Skin Care, Anti-Aging.

Nanomedicine is a natural application for bionanotechnology. After all, the human body is designed for maximal function of biological molecules. This is ideal for nanomedicine, because we can use the raw materials that nature has given to us. For example, our body’s immune system gives us tools for seeking out pathogens and quickly dispatching them. The blood clotting system helps us to patch major damage in a matter of seconds, and the processes of wound healing show us how to forge lasting repairs. Now, nanotechnology has blessed us with the ability to tailor these tools to perform functions that nature has overlooked.

Tools

Potential application of tools

- Cantilevers and carbon nanotubes find their applications in high throughput screening of diseases, disease protein biomarker detection, DNA mutation detection (SNPs), and gene expression detection studies.
- Dendrimers may be helpful in target sequestration, controlled release drug delivery and as image contrast agents.
- Nanocrystals are mainly used in improved formulation of poorly soluble drugs.
- Nanoparticles are used in multifunctional therapeutics; as permeation enhancers, MRI and ultrasound image contrast agents, reporters of apoptosis, angiogenesis, etc.
- Nanoshells are used in tumor-specific imaging and deep tissue tumor cell thermal ablation.
- Quantum dots find potential application in optical detection of genes and proteins in animal models and cell assays; and in tumor and lymph node visualization.

Techniques and Implements

Techniques in nanomedicine involve microscopic techniques and implements used to visualize cells, bacteria, viruses and single molecules at the nanoscale. These range from the atomic force microscope (AFM), scanning tunneling microscope (STM) to molecular modelling software and various production technologies.

Materials

Nanomaterials can be used as biocompatible materials or coatings in drug encapsulation, bone replacements, prostheses, and implants. Examples of nanostructured materials include *quantum dots* (nanostructures which force atoms to occupy discrete energy states as in biological markers), and dendrimers (branched polymers used for drug delivery, filtration and chemical markers).

Nanotechnology in Anti-AIDS drugs

Rational drug design is a major triumph of current nanomedicine. HAART (*Highly Active Antiretroviral Therapy)* is a successful example of rational drug design.

HIV is arguably the best-characterized organism known to science, and this knowledge has been aggressively pressed to service in the fight against AIDS. In a matter of decade, AIDS has changed from a uniformly deadly disease to a manageable disease in many cases, because of nanoscale design of effective anti-HIV drugs.

Bioresorable Materials

Bioresorable polymers are currently used in degradable medical applications like sutures and orthopaedic fixation devices. Bioresorable implants will biodegrade and do not have to be removed manually. Research is being done on a flexible nanofiber membrane mesh that can be applied to heart tissue in open-heart surgery. The mesh is infused with antibiotics, pain-killers and medicines in small quantities, and then applied directly to the heart's tissues.

Drug Encapsulation

Protection to drugs as they are delivered through the body involves drug encapsulation materials like liposomes and polymers. The materials form capsules around the drugs and permit timed drug release to occur as the drug diffuses through the encapsulation material.

When encapsulation materials are produced from nanoparticles in the 1 to 100nm size range instead of bigger microparticles, they have a larger surface area for the same volume, smaller pore size, improved solubility, and different structural properties. This can improve both the diffusion and degradation characteristics of the encapsulation material.

Some simply bump into the surfaces of cells and bind weakly (as shown in the left side of Fig. 1). Then any drug carried inside the liposome can slowly leak out, providing a small but consistent dose to the local area. In other cases, the liposomes are drawn into the cell by normal endocytosis mechanisms (center). As they pass through the lysosomes, where internalized molecules are digested, the liposome is degraded and the molecules inside are released. Finally, in special cases, liposomes can be designed to fuse with the cell surface (right). They then dump their contents into the cell and incorporate their lipids directly in to the cell membrane.

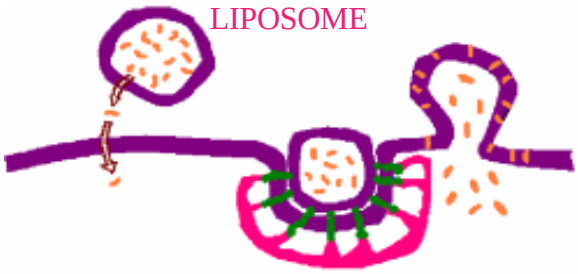

Fig 1. Liposome interaction with cells in several different ways

Other applications of nanotechnology in medicine are as follows:

- Artificially designed haemoglobin with effective oxygen delivery system and improved lifespan finds its place in blood transfusions, as whole blood has short shelf life.
- Biosensors detect glucose levels for management of diabetes.
- Biomimetics is a frequently used term to describe the use of concepts and principles from nature and their application for creating new materials, devices and systems. Emulating the concepts and principles of biology has led to the controlled self-assembly of biopolymeric materials, of arrays of nanoparticles, of devices for use in nanoelectronics, and of macromolecular crystals.

- Surface-directed nanobiotechnology techniques for the manipulation of molecules within cells, including use of bioselective surfaces, control of biofouling and cell culture.
- Dendritic polymers have been used for the production of diagnostics for the earlier detection of cancer. These polymers have also been used to develop new delivery methods for performing therapeutic functions in vivo and to construct nanostructured scaffolds for drug delivery with about 97% porosity.
- Engineered nanopores detect specific DNA sequences.

Diatom Nanotechnology

To build anything at present, materials scientists have to meticulously etch silicon wafers, painstakingly manufacture buckyballs and nanotubes to exact specifications, or laboriously push single atoms around using an atomic force microscope. Diatoms promise to put an end to all this hard labour. Diatoms are unicellular plants occurring in almost every aquatic environment. Their main morphological character is the frustule, a silica cell wall that consists of two valves, encasing the protoplasm, joined together by a girdle. The girdle is composed of a series of silica bands (copulae) linked together along their margins. In several diatom species, the first girdle bands (valvocopulae), which associate the valves with the rest of the girdle, appear different in shape and bring specific nanostructures devoted to facilitate this linkage. The species of the diatom family Cocconeidaceae show elaborate linkage systems between the valves in which functionally complex valvocopulae are involved. The advantage with a diatom is that it grows complex structures in three dimensions directly while most human technology can only do 3D by building layer after layer - and so far none can match the diatom for complexity.

Magnetized frustules have many potential engineering and medical applications. Medicines/vaccines can be loaded into the pores, then delivered (and held) by magnetic field manipulation at a target location in a human/animal body. Similarly, iron-doped frustules can be mobile vehicles within the human body for targeted exposure of cancerous lesions to radioactive isotopes. Frustules are used to build a strong, continuous diatom-based membrane that is both permeable and selective which is used as gas-selective membrane in equipment such as gas filter masks.

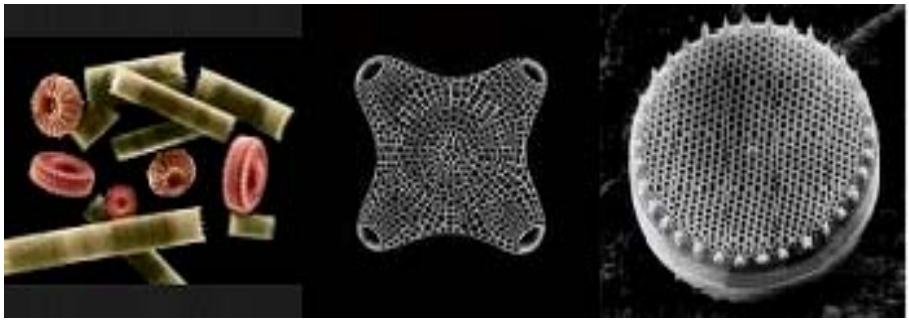

Fig 2. Nanostructures of diatom frustules

Nanoproducts under development

Product	Type of Nanomaterial	Indication	Phase	Company
AmBisome	Liposome	Fungal infections	Approved	Gilead Sciences
Doxil	Pegylated liposome	Metastatic ovarian cancer	Approved	OrthoBiotech
VivaGel MRX-952	Dendrimer Branching block copolymer self-assembled nanoparticulate formulation of irinotecan metabolite	Tropical microbicide for HIV Oncology	Phase 1 Preclinical	Star Pharma ImaRx Therapeutics
Definity	Lipid-encapsulated octofluoropropane nanospheres	Echocardiogram contrast agent	Approved	ImaRx/BMS
MRX-815 Abraxane	Nanobubbles Nanoparticulate albumin	Vascular thrombosis Non-small cell lung cancer, breast cancer, others.	Phase 1 NDA filed	ImaRx American Pharmaceutical Partners
Cydosert-camptothecin	Cydodextrin nanoparticle	Metastatic solid tumours	IND filed	Insert Therapeutics
TNT-Anti-Ep-CAM	Polymer coated iron oxide	Solid tumours	Preclinical	Triton BioSystems
Rapamune Emend Leunesse	Nanocrystalline drug Nanocrystalline drug Solid lipid nanoparticles	Immunosuppresant for kidney transplantation Nausea Cosmetics	Approved Approved On market	Elan/ Wyeth Elan/Wyeth NanoTherapeutics
Verigene platform	DNA-functionalised gold nanoparticles	Diagnostics	On market	Nanosphere
IINGN-401 Combidex	Liposome Iron oxide nanoparticle	Metastatic lung cancer Tumour imaging	Phase 1 NDA filed	Introgen Advanced Magnatics

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RECENT NEWS IN BRIEF

Decline in whale birth rate tied to global warming according to study

By observing more than 1,800 right whales in the southern Atlantic, researchers have determined that changes in climate are affecting the whales' reproductive success. The problem, experts believe, is not that whales suffer directly from warm conditions, but that their food supply-mainly krill-does. In their study, scientists compared sea-surface temperatures in the southwest Atlantic to their index of the yearly calving success of whales that breed off the Argentine coast. Researchers found a strong correlation between the number of right whale calves born and changes in sea-surface temperature in the autumn of the preceding year. Previous data support a significant relationship between sea-surface temperature and the breeding success of krill-loving gentoo penguins. Leaper says the new study, which appears in the current online issue of the Journal Biology Letters, has implications for whaling policy as well. Quoting the Japanese government, Leaper said that their motivation for scientific whaling is "to take into account species interaction [ecosystem] effects in understanding the dynamics of the baleen whale species in the Antarctic ecosystem and predicting future trends in their abundance and population structure." But if that is their aim, Leaper says, hunting/killing whales is not the best strategy. "Our results would indicate that long-term studies of live whales are much more likely to achieve this objective than the Japanese whaling program." For more information log on to http://news.nationalgeographic.com/news/2006/01/0118_060118_ right_whales.html

UK reports that research is needed on marine sound

Research into the effect of sound in the oceans on marine mammals should be commissioned by the UK Government, a report recommends. The Inter-agency Committee on Marine Science and Technology says mammals are affected by many sounds, including sonar, oil exploration and shipping. It suggests research should include deliberately exposing mammals to noise. There has been speculation that the whale found in the Thames last month had been disorientated by sounds. The Inter-Agency Committee (IACMST) brings together experts from government departments and academia and reports to the government's Office of Science and Technology. Its new report identifies 13 cases of strandings by whales and dolphins which appear to have been linked to specific sources of noise; most of those sources involved naval vessels. For more information log on to http://news.bbc.co.uk/2/hi/science/nature/4706670.stm

Netherlands Antilles: New species of fish and seaweeds found on Caribbean's Saba bank

An underwater two week expedition in January by scientists from Conservation International (CI), the Netherlands Antilles government and Smithsonian Institution's Museum of Natural History has brought to light new species of fish, seaweed and other ocean life at little-studied Saba Bank Atoll, a coral-crowned seamount 250 kilometers southeast of Puerto Rico in the Dutch Windward Islands. The unprecedented richness of marine life and vulnerable status of the atoll's coral beds make Saba Bank a prime candidate for designation as a Particularly Sensitive Sea Area (PSSA) under the International Maritime Organization (IMO). Mark Littler, marine botanist of the Smithsonian Institution's National Museum of Natural History, declared Saba Bank the richest area for seaweeds in the Caribbean basin, including as many as a dozen new species along with commercially valuable species that will

facilitate the creation of economic activity zones under PSSA designation. Paul Hoetjes, marine biologist with the Ministry of Nature Affairs for the Netherlands Antilles (MINA), called the expedition crucial to getting the area protected to benefit local populations. For more information log on to http://www.conservation.org/xp/news/ press_releases/2006/021406.xml

UK government report on impact of climate change

Rising concentrations of greenhouse gases may have more serious impacts than previously believed, a major scientific report has said. The report, published by the UK government, says there is only a small chance of greenhouse gas emissions being kept below "dangerous" levels. It fears the Greenland ice sheet is likely to melt, leading to sea levels rise by 7m (23ft) over 1,000 years. The report, Avoiding Dangerous Climate Change, collates evidence presented by scientists at a conference hosted by the UK Meteorological Office in February 2005. For more information log on to http://www.metoffice.gov.uk/corporate/pressoffice/adcc/; http://news.bbc.co.uk/1/hi/sci/tech/4660938.stm

A 20th century acceleration in rate of sea-level rise

Research by Australian climate scientists has shown that global sea level has been rising at an increasing rate over the past 130 years. Using information from tide gauges and measurements from satellites, Dr. John Church and Dr Neil White estimated changes in global mean sea levels since 1870. Their work, published in the science journal Geophysical Research Letters (6 January), indicates an acceleration in the rate of sea-level rise that had not been detected previously. For more information log on to http://www.csiro.au/csiro/content/standard/ps13f.html

Corals and Mangroves in Front Line

The economic value and life saving function of coral reefs and mangroves are brought into sharp focus in this new report by the United Nations Environment Programme (UNEP). The report underlines the vital role these natural features play in tourism, stemming coastal erosion and acting as nurseries for fish including those in the multi-million dollar aquaria trade. The report recognises that corals and mangroves absorb up to 90 per cent of the energy of wind-generated waves. It is also underlines that conserving them is a small price to pay when set against the costs of destroying them or substituting their role with man-made structures. For more information log on to www.unep-wcmc.org/resources/PDFs/In_the_front_line.pdf

Marine Scientists Report Massive "Dead Zones"

Rising tides of untreated sewage and plastic debris are seriously threatening marine life and habitat around the globe, the United Nations Environment Programme (UNEP) warned in a recently released report. The number of ocean "dead zones" has grown from 150 in 2004 to about 200 today, said Nick Nuttall, a UNEP spokesperson. Dead zones can encompass areas of ocean 100,000 square kms in size where little can live because there is no oxygen left in the water. Nitrogen pollution, mainly from farm fertilizers and sewage, produces blooms of algae that absorb all of the oxygen in the water when they decompose. Growing global populations, mainly concentrated along coastlines, and the resulting increase in untreated sewage are endangering human health and wildlife, as well as livelihoods from fisheries to tourism, according to the "State of the Marine Environment" report. For more information log on to http://www.unep.org

Source: United National Environmental Programme

Stakeholders at Thai meet discuss sustainable management of mangroves

Non-governmental organization repre-sentatives, local community leaders from Phang-Nga and Phuket, local fishing communities and volunteers from the Wildlife and Fauna Protection of Thailand under HM the Queen gathered to discuss community-based mangrove forest management.

The programme, supported by the United Nations Development Programme (UNDP), was implemented from October 2004 to September 2006 with the aim to come up with appropriate mangrove forest management measures with the local communities as stakeholders. They are expected to apply local wisdom and networking approaches. There are two major locations for mangroves in Phuket, which are at Paklok and Bangrong, while Phang-Nga has eight locations. For more information log on to http://www.thaisnews.com

After tsunami, waves of corruption Sweep Indonesia

The outpouring foreign aid and donations to Indonesia in the wake of the December 2004 tsunami are being pilfered by corrupt government officials and their affiliated business interests. That's the disturbing conclusion of a number of independent studies conducted by anti-graft watchdogs focused on the reconstruction efforts in the tsunami-hit province of Aceh, where an estimated 167,700 people were killed, 37,000 went missing and 500,000 were internally displaced by the killer waves. Total damages were estimated by the government at more than US$4.5 billion. Amid all that loss and suffering, the list of documented corruption allegations is growing, and even officials attached to the government's Aceh and Nias Rehabilitation and Reconstruction Agency, known locally as the BRR, openly admit to corruption among their ranks. For details contact: John McKnight (mcknight.jk @gmail.com)

Coastal environment of Kerala, India, under threat, says study

Land use changes, waste disposal, coastal erosion, tourism, coastal engineering activities and sand-mining are exerting pressure on the marine and coastal environment of the south Indian State of Kerala, according to a survey carried out by the Kerala State Council for Science, Technology and Environment. About 300 medium & large-scale and about 2,000 small-scale industries are discharging effluents directly into saline or freshwater bodies. It is estimated that about one million cubic metres of sewage is generated daily in the coastal areas and about 30,000 cubic metres of this reaches surface water bodies in the coastal areas. The study reports the over-exploitation of resources such as mangroves, fisheries, sand and landspace. The record growth of tourism is identified as a major reason for the mounting pressure on the environment. The fisheries sector is facing pressure from excess fishing fleet, habitat degradation, overfishing and juvenile fishery. Extraction of sand from the beaches and wetland reclamation are also rampant, it says.

Industrial and municipal waste disposal has impacted the water quality and biological environment in coastal water bodies. Wetlands, mangroves, mud banks, beaches, estuaries and cliffs, which are important habitats of the marine and coastal environment, are reported to be in various stages of degradation. While wetlands are being reclaimed, mangroves are mostly destroyed for development of urban space and construction of ports and shrimp farms. Reclamation, silting and industrial & municipal pollution are damaging the estuarine and backwater ecosystems. The Kochi backwaters and the coastal areas in Alappuzha, Kayamkulam, Kollam,

Paravur and Veli are identified as some of the hotspots in the State. According to the survey, bottom trawling poses a major threat to the marine ecosystem along the coast of Kerala. The inadvertent removal of some organisms, it points out, would impair the dynamics of the food chain and affect the whole ecosystem. A similar situation has been reported in the backwaters where the stake net method of fishing removes a wide array of non- target organisms, which are functionally important to the aquatic environment. Other destructive types of fishing and pollution also impact the ecology. Active fishing with synthetic fibres, modification of fishing craft and gear and indigenisation of fishing techniques such as mini-purse-seining and mini-trawling have contributed to overexploitation of fin and shell fishes in the seas. The survey says the overexploitation had led to massive changes in the species composition of the catch and the disappearance of previously important species. For more information log on to http://www.hindu.com/2006/09/13/stories/2006091303440500.htm

Almost no more seafood after 2048 at current rate of exploitation, study warns

Seafood will be all but a memory by 2048 if bulging human populations keep devouring fish and polluting oceans at current rates, warns a study published in the Nov. 3 issue of the research journal *Science*.

"Species have been disappearing" faster and faster, said lead author Boris Worm of Dalhousie University in Halifax, Canada. "If this trend continues, all fish and seafood species are projected to collapse within my lifetime."

"Collapse" is de-fined as the catch of a species dropping by 90 percent, said Worm, one of the groups of ecologists and economists studying how marine biodiversity helps to sustain humanity.

"Worm and colleagues have provided the first comprehensive assessment of the state of ecosystem services provided by the biodiversity of the world's oceans to humanity," said *Science* international managing editor Andrew Sugden.

The study is based on a wide array of historical and experimental data, he added.

Twenty-nine percent of fish and seafood species have collapsed already, Worm said. "It is a very clear trend, and it is accelerating. We don't have to use models to understand this trend; it is based on all the available data."

The problem is much greater than losing a key source of food, he added. Damage to oceans affects not only fisheries, but the ocean ecosystem's overall productivity and stability, he said. A dwindling variety of species have a harder time maintaining water quality through biological filtering, protecting shorelines, controlling harmful algal growths and preserving oxygen levels.

"The good news is that it is not too late to turn things around," Worm said. The scientists studied 48 areas worldwide that have been protected to improve marine biodiversity. "We see that diversity of species recovered dramatically, and with it the ecosystem's productivity and stability."

"We hardly appreciate living on a blue planet," Worm said. "The oceans define our planet, and their fate may to a large extent determine our fate." Courtesy : Nature and World Science staff.

FORTHCOMING RESEARCH MEETS

15-18 May 2007. 5th International Fisheries Observer Conference. Contact: Victoria, British Columbia, Canada. Website: http://www.fisheriesobserverconference.com

6-8 June 2007. Fourth International Reservoir Symposium: Balancing Fisheries Management and Water Uses for Impounded River Systems. Contact: Atlanta, Georgia, USA and Mike Colvin (Mike.Colvin@mdc.co.gov)

17-24 June 2007. Challenges for Diadromous Fishes in a Dynamic Global Environment. Contact: Halifax, Nova Scotia, Canada. Alex Haro, Alex_Haro@usgs.gov; Website:http://www.anacat.ca

2-6 September 2007. American Fisheries Society, 137th Annual Meeting, San Francisco, California, USA. Contact: Betsy Fritz, bfritz@fisheries.org; Website http://www.fisheries.org

2-6 September 2007. Fish Stock Assessment Methods for Lakes and Reservoirs: Towards the True Picture of Fish Stock. Contact: Ceske Budejovice, Czech Republic. Dr E Hohausova, fsamlr07@centrum.cz; Website: http://fsamlr2007.czweb.org

16-20 September 2007 (WETPOL 2007). 2nd International Symposium on Wetland Pollutant Dynamics and Control, Tartu, Estonia. For more information contact: e-mail: wetpol2007@ut.ee; Website: http://www.geo.ut.ee/wetpol2007.

19-23 May 2008. World Aquaculture 2008. Contact: Busan, Korea. Website: http://www.was.org

16-20 August 2008. American Fisheries Society, 138th Annual Meeting, Ottawa, Ontario, USA. Contact: Betsy Fritz, bfritz@fisheries.org. Website: http://www.fisheries.org

28 October 2008 - 4 November 2008. Tenth conference of the parties to the ramsar convention, Changwon, Republic of Korea. For more information contact: Ramsar Secretariat; tel: +41-22-999-0170; fax: +41-22-999-0169; e-mail: ramsar@ramsar.org; Internet: http://www.ramsar.org

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