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Ahn, S., D.M. Kulis, D.L. Erdner, D.M. Anderson, and D.R. Walt
Applied and Environmental Microbiology, pp. 5742-5749, 2006 WHOI-R-06-006
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Fibre Optic Microarrays for the Detection and Enumeration of Harmful Algal Bloom Species
Anderson, D.M., D. Kulis, D. Erdner, S. Ahn, and D. Walt
African Journal of Marine Science 2006, Vol. 28, No. 2, pp. 231-235, 2006 WHOI-R-06-008
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Accumulation of Red Tide Toxins in Larger Size Fractions of Zooplankton Assemblages from Massachusetts Bay, USA
Turner, J.T., G.J. Doucette, C.L. Powell, D.M. Kulis, B.A. Keafer, and D.M. Anderson
Marine Ecology Progress Series, 13 pp., 2000 WHOI-R-00-013

Estimated Annual Economic Impacts from Harmful Algal Blooms (HABs) in the United States
Only available on loan from the National Sea Grant Library
Anderson, D.M., P. Hoagland, Y. Kaoru, and A.W. White
101 pp., 2000 WHOI-T-00-002 (WHOI Technical Report WHOI-2000-11)

Detection of the Toxic Dinoflagellate Alexandrium fundyense (Dinophyceae) wtih Oligonucleotide and Antibody Probes: Variability in Labeling Intensity with Physiological Condition
Anderson, D.M., D.M. Kulis, and B.A. Keafer
J. Phycol., Vol. 35, pp. 870-883, 1999 WHOI-R-99-004

Harmful Algal Blooms (HABs) in the United States
Helpful to educators and students.
WHOI Sea Grant
Focal Points, 3 pp., 1998 WHOI-G-98-004
Also available online: click here

Physiology and Bloom Dynamics of Toxic Alexandrium Species, with Emphasis on Life Cycle Transitions
Anderson, D.M.
In: NATO ASI Series: Physiological Ecology of Harmful Algal Blooms (Anderson, D.M., A.D. Cembella, andG.M. Hallegraeff, eds.), Vol. G41, pp. 29-48, 1998 WHOI-R-98-002

Turning Back the Harmful Red Tide
Anderson, D.M.
Nature, Vol. 388, pp. 513-514, 1997 WHOI-R-97-004

Immunomagnetic Separation of Cells of the Toxic Dinoflagellate Alexandrium fundyense from Natural Plankton Samples
Aguilera, A., S. Gonzalez-Gil, B.A. Keafer, and D.M. Anderson
Marine Ecology Progress Series, Vol. 143, pp. 255-269, 1996 WHOI-R-96-013

LSU rDNA-Based RFLP Assays for Discriminating Species and Strains of Alexandrium (Dinophyceae)
Scholin, C.A. and D.M. Anderson
J. Phycol., Vol. 32, pp. 1022-1035, 1996 WHOI-R-96-012

Widespread Phagocytosis of Ciliates and Other Protists by Marine Mixotrophic and Heterotrophic Thecate Dinoflagellates
Jacobson, D.M. and D.M. Anderson
J. Phycol., Vol. 32, pp. 279-285, 1996 WHOI-R-96-003

Marine Toxins: Studies Unravel Mystery of Public Health Threat
2 pp., 1994 WHOI-G-94-002

Red Tides
Anderson, D.M.
Scientific American, Vol. 271, No. 2, pp. 62-68, 1994 WHOI-R-94-001

Biogeography of Toxic Dinoflagellates in the Genus Alexandrium from the Northeastern United States and Canada

Anderson, D.M., D.M. Kulis, G.J. Doucette, J.C. Gallagher, and E. Balech
Marine Biology, Vol. 120, pp. 467-478, 1994 WHOI-R-94-005

An Immunofluorescent Survey of the Brown Tide Chrysophyte Aureococcus anophagefferens Along the Northeast Coast of the United States
Anderson, D.M., B.A. Keafer, D.M. Kulis, R.M. Waters, and R. Nuzzi
Journal of Plankton Research, Vol. 15, No. 5, pp. 563-580, 1993 WHOI-R-93-006
Surveys were conducted along the northeast coast of the U.S.A., between Portsmouth, New Hampshire, and the Chesapeake Bay in 1988 and 1990, to determine the population distribution of Aureococcus anophageefferens, the chrysophyte responsible for massive and destructive brown tides in Long Island and Narragansett Bay beginning in 1985. Both years, A. anophagefferons was detected at numerous stations in and around Long Island and Barnegat Bay, New Jersey, typically at high cell concentrations. To the north and south of this 'center,' nearly half of the remaining stations were positive for A. anophagerrons, but the cells were always at very low cell concentration. Many of the positive identifications in areas distant from Long Island were in waters with no known history of harmful brown tides. The species was present in both open coastal and estuarine locations, in salinities between 18 and 32 practical salinity units (PSU). The observed population distributions apparently still reflect the massive 1985 outbreak when this species first bloomed, given the number of positive locations and high abundance of A. anophagerrons in the immediate vicinity of Long Island. However, the frequent occurrence of this species in waters far from the population 'center' is disturbing. Aureococcus anophagerrons is more widely distributed than was previously thought. Numerous areas thus have the potential for destructive brown tides such as those associated with the sudden appearance of the species in 1985.

Use of Remotely-sensed Sea Surface Temperatures in Studies of Alexandrium tamarense Bloom Dynamics
Keafer, B.A. and D.M. Anderson
In: Smayda, T.J. and Y. Shimizu (eds.), Toxic Phytoplankton Blooms in the Sea, Elsevier Science Publishers B.V., pp. 763-768, 1993 WHOI-R-93-003
Remote sensing of sea surface temperatures (SST) has proven to be a useful tool in studies of the bloom dynamics of Alexandrium tamarenseand the onset of PSP in the southwestern Gulf of Maine. A warm coastal current (= plume) formed from spring runoff that is believed to be responsible for the southerly transport of A. tamarense along the coast in this region was easily resolved in SST imagery. Coastal upwelling, which moved the warmer A. tamarense-containing buoyant plume offshore and away from nearshore shellfish, was detected in two of the three years of this study. The imagery provides valuable insights into the short-term oceanographic processes responsible for the development and behavior of the plume and the distribution of A. tamarense. Remotely-sensed SST has great promise as a tool to provide early warning of the conditions conductive for bloom development, transport, and the initiation of PSP in the region.

Paralytic Shellfish Poisoning on Georges Bank: In Situ Growth or Advection of Established Dinoflagellate Population?
Only available on loan from the National Sea Grant Library
Anderson, D.M. and B.A. Keafer
In: Wiggin, J. and C.N.K. Mooers (eds.), Proceedings of the Gulf of Maine Scientific Workshop, 8-10 January 1991, Woods Hole, MA. Gulf of Maine
Council on the Marine Environment. Urban Harbors Institute, University of Massachusetts, Boston, pp. 217-223, 1992 WHOI-R-91-014

Toxic Phytoplankton Blooms in the Southwestern Gulf of Maine: Testing Hypotheses of Physical Control Using Historical Data
Franks, P.J.S. and D.M. Anderson
Marine Biology, Vol. 112, pp. 165-174, 1992 WHOI-R-92-002

Alongshore Transport of a Toxic Phytoplankton Bloom in a Buoyancy Current: Alexandrium tamarense in the Gulf of Maine
Franks, P.J.S. and D.M. Anderson
Marine Biology, Vol. 112, pp. 153-164, 1992 WHOI-R-92-003
The authors examined the mechanisms controlling blooms of the toxic dinoflagellate Alexandrium tamarense Lebour and the concomitant patterns of shellfish toxicity in the southwestern Gulf of Maine, U.S.A. During a series of cruises from 1987 to 1989, hydrographic parameters were measured to elucidate the physical factors affecting the distribution and abundance of dinoflagellates along this coast. In 1988 and 1989 when toxicity was detected in the southern part of this region, A. tamarense cells were apparently transported into the area between Portsmouth, New Hampshire, and Cape Ann, Massachusetts, in a coastally trapped buoyant plume. This plume appears to have been formed by the outflow from the Androscoggin and Kennebec Rivers. Flow rates of these rivers, hydrographic sections, and satellite images led the authors to conclude that the plume persisted for about a month, and extended alongshore for several hundred kilometers.

Burial of Living Dinoflagellates Cysts in Estuarine and Nearshore Sediments
Keafer, B.A., K.O. Buesseler, and D.M. Anderson
Marine Micropaleontology, Vol. 20, pp. 147-161, 1992 WHOI-R-92-009
This paper describes research into the deposition and burial of living dinoflagellate cysts in two different environments--the nearshore waters of the southern Gulf of Maine and a small, shallow pond on Cape Cod, Massachusetts.

Separation and Concentration of Living Dinoflagellate Resting Cysts from Marine Sediments via Density-gradient Centrifugation
Schwinghamer, P., D.M. Anderson, and D.M. Kulis
Limnol. Oceanogr., Vol. 36, No. 3, pp. 588-592, 1991 WHOI-R-91-012

Toxin Variability in Alexandrium Species

Anderson, D.M.
In: Graneli, E., B. Sundstroem, L. Edler, and D.M. Anderson (eds.), Toxic Marine Phytoplankton, Elsevier, pp. 41-51, 1990 WHOI-R-90-022

Toxin Composition Variations in One Isolate of the Dinoflagellate Alexandrium fundyense
Anderson, D.M., D.M. Kullis, J.J. Sullivan, and S. Hall
Toxicon, Vol. 28, No. 8, pp. 885-893, 1990 WHOI-R-90-017

Dynamics and Physiology of Saxitoxin Production by the Dinoflagellate Alexandrium spp.
Anderson, D.M., D.M. Kullis, J.J. Sullivan, S. Hall, and C. Lee
Marine Biology, Vol. 104, pp. 511-524, 1990 WHOI-R-90-001

Biochemical Composition and Metabolic Activity of Scrippsiella trochoidea (Dinophyceae) Resting Cysts
Binder, B.J. and D.M. Anderson
Journal of Phycol., Vol. 26, pp. 289-298, 1990 WHOI-R-90-004

Uptake Kinetics of Paralytic Shellfish Toxins from the Dinoflagellate Alexandrium fundyense in the Mussel Mytilus edulis
Bricelj, V.M., J.H. Lee, A.D. Cembella, and D.M. Anderson
Mar. Ecol. Prog. Ser., Vol. 63, pp. 177-188, 1990 WHOI-R-90-026

Dinoflagellate Blooms and Physical Systems in the Gulf of Maine
Only available on loan from the National Sea Grant Library
Franks, P.J.S.
Ph.D. Thesis, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Oceanography and Oceanographic Engineering, 253 pp., 1990 WHOI-X-90-003

Changes in Cell Composition During the Life Cycle of Scrippsiella trochoidea (Dinophyceae)
Lirdwitayaprasit, T., T. Okaichi, S. Montani, T. Ochi, and D.M. Anderson
Journal of Phycology, Vol. 26, pp. 299-306, 1990 WHOI-R-90-025

Anatomical Distribution of Paralytic Shellfish Toxins in Soft Shell Clams
Martin, J.L., A.W. White, and J.J. Sullivan
In: Graneli, E., B. Sundstroem, L. Edler and D.M. Anderson (eds.), Toxic Marine Phytoplankton, Elsevier, pp. 379-384, 1990 WHOI-R-90-024
Blooms of Alexandrium fundyense are an annual summer occurrence in the Bay of Fundy and are responsible for soft shell clams, Mya arenaria, accumulating paralytic shellfish toxins while filter feeding which result in the closure of most areas to harvesting. Shellfish toxicities for the southern Bay of Fundy behave as a unit and follow the Alexandrium bloom closely due to the tremendous turbulence and mixing within the system. Since 1980, several soft shell clam sites have remained closed year-round due to low, but unacceptable levels of PSP toxins. Although prior reports suggested the use of ozone for detoxifying clams, the authors' efforts to do so from a permanently closed area such as the one in the study (Crow Harbour), with toxins stored for long periods, proved unsuccessful. This study was undertaken by the investigators to determine whether clams from an area where natural detoxification does not occur behave in a similar manner to those from an area where detoxification occurs, and how the toxins are transformed or retained.

Encystment of Chattonella Antique in Laboratory Cultures
Nakamura, Y., T. Umemori, M. Watanabe, D.M. Kulis, and D.M. Anderson
Journal of the Oceanographic Society of Japan, Vol. 46, pp. 35-43, 1990 WHOI-R-90-016

Has There Been a Global Expansion of Algal Blooms? If so, is There a Connection with Human Activities?
Helpful to educators and students.
Smayda, T.J. and A.W. White
In: Graneli, E., B. Sundstroem, L. Edler and D.M. Anderson (eds.), Toxic Marine Phytoplankton, Elsevier, pp. 516-517, 1990 WHOI-R-90-014

International Red Tide Information and Assistance Service
White, A.W.
In: Graneli, E., B. Sundstroem, L. Edler and D.M. Anderson (eds.), Proceedings of the Fourth International Conference on Toxic Marine Phytoplankton, Elsevier, New York, pp. 509-511, 1990 WHOI-R-90-013

Toxic Algal Blooms: An International Directory of Experts in Toxic and Harmful Algal Blooms and Their Effects on Fisheries and Public Health
Only available on loan from the National Sea Grant Library
White, A.W.
216 pp., 1990 WHOI-D-90-001
Toxic and harmful algal bloom events are increasing in frequency, intensity and geographic distribution around the world. They now constitute a global problem for fisheries, mariculture and public health. Developing countries are especially vulnerable to these

occurrences because they lack the scientific and managerial expertise and infrastructure to deal with the resulting fisheries and public health emergencies. There is a pressing need for international coordination and cooperation on toxic phytoplankton blooms and their effects. This international directory lists scientists, fisheries managers, public health officials and physicians who are experienced in dealing with toxic and harmful algal bloom episodes and their impact on fisheries and public health. The directory is intended to improve and accelerate international information exchange on toxic and harmful algal blooms and to foster international assistance with red tide emergencies, particularly in developing countries. It is hoped that it will facilitate rapid access to experts who can respond quickly to toxic algal bloom outbreaks and thus help in reducing the consequences to fisheries and public health.

Toxic Algal Blooms and Red Tides: A Global Perspective
Anderson, D.M.
In: Okaichi, T., D.M. Anderson, and T. Nemoto (eds.), Red Tides: Biology, Environmental Science and Toxicology, Elsevier Science Publishing Co., Inc., New York, pp. 11-16, 1989 WHOI-R-89-001

Toxic Dinoflagellates and Marine Mammal Mortalities: Proceedings of an Expert Consultation Held at the Woods Hole Oceanographic Institution on May 8-9, 1989
Only available on loan from the National Sea Grant Library
Anderson, D.M. and A.W. White (eds.)
Woods Hole Oceanographic Institution Technical Report WHOI-89-36 (CRC89-6), 65 pp., 1989 WHOI-W-89-002
Two events in 1987-1988 involved unprecedented mortalities of humpback whales and bottlenose dolphins, species that have never been associated with typical mass strandings. The unusual characteristics of these two events were such that standard protocols for examining stranded animals were expanded to include analysis for dinoflagellate neurotoxins that have, in the past, been associated with mass kills of fish and other marine mammals. The circumstantial evidence presently available has sufficient implications with respect to marine mammal mortalities, commercial fisheries, and public health to justify future investigations into the impact of dinoflagellate toxins on higher trophic levels. A series of research and monitoring programs is suggested.

Paralytic Shellfish Poisoning in Northwest Spain: The Toxicology of the Dinoflagellate Gymnodinium catenatum
Anderson, D.M., J.J. Sullivan, and B. Reguera
Toxicon, Vol. 27, No. 6, pp. 665-674, 1989 WHOI-R-89-013

Trophic Interactions Between Nano- and Microzooplankton and the "Brown Tide"
Caron, D.A., E.L. Lin, H. Kunze, E.M. Cosper, and D.M. Anderson
In: Cosper, E.M., E.J. Carpenter, and M. Bricelj (eds.) Novel Phytoplankton Blooms: Causes and Impacts of Recurrent Brown Tide and Other Unusual Blooms. Coastal and Estuarine Studies, Springer-Verlag, New York, Vol. 35, pp. 265-294, 1989 WHOI-R-89-023

Chain-forming Dinoflagellates: An Adaptation to Red Tides
Fraga, S., S.M. Gallager, and D.M. Anderson
In: Okaichi, T., D.M. Anderson, and T. Nemoto, (eds.) Red Tides: Biology, Environmental Science and Toxicology, pp. 281-284, 1989 WHOI-R-89-003

Sampling Coastal Dinoflagellate Blooms: Equipment, Strategies, and Data Processing
Franks, P.J.S. and D.M. Anderson
In: Hallegraeff, G.M. and J.L. McLean (eds.), Biology, Epidemiology, and Management of Prodinium Red Tides, pp. 235-254, 1989 WHOI-R-89-020

Fronts, Upwelling and Coastal Circulation: Spatial Heterogeneity of Ceratium in the Gulf of Maine
Franks, P.J.S., D.M. Anderson, and B.A. Keafer
In: Okaichi, T., D.M. Anderson, and T. Nemoto, (eds.) Red Tides: Biology, Environmental Science and Toxicology, pp. 153-156, 1989 WHOI-R-89-002

Ultrastructural Aspects of Sexual Reproduction in the Red Tide Dinoflagellate Gonyaulax tamarensis
Fritz, L., D.M. Anderson, and R.E. Triemer
J. Phycol., Vol. 25, pp. 95-107, 1989 WHOI-R-89-006

Humpback Whales Fatally Poisoned by Dinoflagellate Toxin
Geraci, J.A., D.M. Anderson, R.J. Timperi, D.J. St. Aubin, G.A. Early, J.A. Prescott, and C.A. Mayo
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 46, pp. 1895-1898, 1989 WHOI-R-89-024

Variation Among Congeneric Dinoflagellates from the Northeastern United States and Canada
Hayhome, B.A., D.M. Anderson, D.M. Kulis, and D.J. Whitten
Marine Biology, Vol. 101, pp. 427-435, 1989 WHOI-R-89-012

Testing and Application of Biomonitoring Methodologies for Assessing Environmental Effects of Noxious Algal Blooms
Tracey, G.A., R.L. Steele, J. Gatzke, D.K. Phelps, R. Nuzzo, R.M. Waters, and D.M. Anderson
In: Cosper, E.M., E.J. Carpenter, and M. Bricelj (eds.) Novel Phytoplankton Blooms: Causes and Impacts of Recurrent Brown Tide and Other Unusual Blooms. Coastal and Estuarine Studies, Springer-Verlag, New York, Vol. 35, pp. 557-574, 1989 WHOI-R-89-025

...And All the Waters Were Turned to Blood...: Red Tide in the Northeast
Helpful to educators and students.
White, A.W.
Nor'easter, Vol. 1, No. 1, pp. 27-31, 1989 WHOI-R-89-010
For hundreds of years people in some parts of the world have known about red tides and their connection with mass kills of marine animals, contamination of shellfish with deadly toxins, and human illness and death. Toxic red tides have become a problem of global dimensions. They now occur in one form or another nearly throughout the world's oceans. This article describes the red tide phenomenon: the organisms that cause it, the effects of red tide, the research being conducted on red tide, and the need for international cooperation in addressing this important coastal problem.

Mortality of Fish Larvae from Eating Toxic Dinoflagellates or Zooplankton Containing Dinoflagellate Toxins
White, A.W., O. Fukuhara, and M. Anraku
In: Okaichi, T., D.M. Anderson, and T. Nemoto, (eds.) Red Tides: Biology, Environmental Science and Toxicology, pp. 395-398, 1989 WHOI-R-89-004
First-feeding red sea bream (Pagrus major) and Japanese anchovy (Engraulis japonica) larvae were fed the toxic dinoflagellate Gonyaulax excavata. Older larvae were fed zooplankton (mostly copepods) that had eaten G. excavata. Despite low toxin content of the dinoflagellates relative to field conditions, effects of the toxins were apparent. The mortality rates of first-feeding red sea bream larvae feeding on Gonyaulax was about three times that of starved controls. First-feeding Japanese anchovy larvae fed poorly on Gonyaulax, and no difference in mortality between treatments and controls was observed. Older larvae of both species showed symptoms typical of paralytic shellfish poisoning (PSP) within a few hours after eating zooplankton that contained Gonyaulax toxins; 20 to 30% of the larvae died. Results indicate that fish larvae, like adult fish, are sensitive to paralytic shellfish toxins and suggest that blooms and red tides of G. excavata and its toxic relative cause kills of larval, as well as adult, fish.

Intracellular Localization of Saxitoxins in the Dinoflagellate Gonyaulax tamarensis
Anderson, D.M. and T.P.O. Cheng
J. of Phycology, Vol. 24, pp. 17-22, 1988 WHOI-R-88-004

The Unique, Microreticulate Cyst of the Naked Dinoflagellate Gymnodinium catenatum
Anderson, D.M., D.M. Jacobson, I. Bravo, and J.H. Wrenn
J. of Phycology, Vol. 24, pp. 255-262, 1988 WHOI-R-88-006

Influence of Upwelling Relaxation on Dinoflagellates and Shellfish Toxicity in Ria De Vigo, Spain
Only available on loan from the National Sea Grant Library
Fraga, S., D.M. Anderson, I. Bravo, B. Reguera, K.A. Steidinger, and C.M. Yentsch
Estuarine, Coastal and Shelf Science, Vol. 27, pp. 349-361, 1988 WHOI-R-88-011

Photosynthetic Response of Gonyaulax tamarensis During Growth in a Natural Bloom and in Batch Culture
Glibert, P.M., T.M. Kana, and D.M. Anderson
Marine Ecology - Progress Series, Vol. 42, pp. 303-309, 1988 WHOI-R-88-002

Assessment of Ciguatera Dinoflagellate Populations: Sample Variability and Algal Substrate Selection
Lobel, P.S., D.M. Anderson, and M. Durand-Clement
Biol. Bull., Vol. 175, pp. 94-101, 1988 WHOI-R-88-010

Distribution and Abundance of the Toxic Dinoflagellate Gonyaulax excavata in the Bay of Fundy
Martin, J.L. and A.W. White
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 45, pp. 1968-1975, 1988 WHOI-R-88-016

Blooms of Toxic Algae Worldwide: Their Effects on Fish Farming and Shellfish Resources
Helpful to educators and students.
White, A.W.
In: Proceedings of the International Conference on Impact of Toxic Algae on Mariculture, Aqua-Nor 1987 International Fish Farming Exhibition, 13-18 August, 1987, Trondheim, Norway, pp. 9-14, 1988 WHOI-R-88-005
Discolored water and its association with kills of fish and other animals has been noted since Biblical times. Ship's logs from hundreds of years ago document discolorations of the sea in many places around the world. The discolorations resulting from high concentrations of microalgae are often of a reddish hue, and hence referred to by the generic term "red tide." Certain bloom-forming algae are toxic; they produce compounds that are toxic to fish or that accumulate in shellfish causing serious illness and sometimes death to humans who eat them. Blooms and red tides of these toxic algae have had significant economic impact on fish and shellfish farming industries in much of the world. Further, the incidence of these toxic blooms appears to be on the increase around the world. This paper, from a presentation at an international conference on the impact of toxic algae on mariculture, is a summary of the major organisms responsible for toxic blooms and red tides in various parts of the world and their effects on fish and shellfish resources, with special reference to mariculture.

PSP: Poison for Fundy Shellfish Culture
Helpful to educators and students.

White, A.W.
World Aquaculture, Vol. 19, No. 4, pp. 23-26, 1988 WHOI-R-88-021
FACT: The risk of molluscan shellfish contamination by paralytic shellfish toxins is high nearly everywhere in Canada's southern Bay of Fundy, one of the richest shellfish areas in the world. FACT: Gonyaulax excavata blooms and paralytic shellfish toxins do not impair the growing of shellfish in the Bay of Fundy because Gonyaulax is a satisfactory food organism and the toxins have little effect on the shellfish. However, the toxins have a major impact on the marketing of all filter-feeding shellfish except the sea scallop, from which only the toxin-free adductor muscle is marketed. FACT: There is no economically viable method for detoxifying or depurating paralytic shellfish toxins in molluscan shellfish, nor is there any known antidote for the toxic effects in humans. Thus the cost of inspecting shellfish for paralytic shellfish toxins must be taken into account in the cost/benefit analysis of shellfish culture operation in areas affected by the dinoflagellate Gonyaulax. This paper looks at these and other important issues relating to PSP in the Bay of Fundy and presents what is currently known about the disease.

An Endogenous Annual Clock in the Toxic Marine Dinoflagellate Gonyaulax tamarensis
Anderson, D.M. and B.A. Keafer
Nature, Vol. 325, No. 6105, pp. 616-617, 1987 WHOI-R-87-002
Blooms of the toxic dinoflagellate Gonyaulax tamarensis cause outbreaks of paralytic shellfish poisoning (PSP) in coastal waters throughout the world. In this paper, the authors present the discovery of a new factor controlling germination of cysts of G. tamarensis from deep coastal waters--an endogenous annual clock that can override an otherwise favorable environment for germination. Similar annual variability in germination has not been observed for cysts of this species from shallow estuaries. The results presented in this paper represent the first conclusive demonstration of an endogenous circannual rhythm in a marine plant. They are evolutionarily and ecologically significant because an endogenous annual clock can lead to the release of motile cells into deep and relatively invariant bottom waters at those times when temperature and light at the surface are suitable for growth. In shallow waters where seasonal variability is large and extends to bottom sediments, a strategy similar to that of the seeds of terrestrial plants would be more appropriate, namely a direct coupling between germination and the external environment.

The Continuing Enigma of Ciguatera
Anderson, D.M. and P.S. Lobel
Biol. Bull., Vol. 172, pp. 89-107, 1987 WHOI-R-87-008

Relationships of Environmental Factors to Toxic Dinoflagellate Blooms in the Bay of Fundy
White, A.W.
Rapp. P.-v Reun. Cons. int. Explor. Mer, Vol. 187, pp. 38-46, 1987 WHOI-R-87-006

Dinoflagellate Cyst Dynamics in Coastal and Estuarine Waters
Anderson, D.M. and B.A. Keafer
Toxic Dinoflagellates, pp. 219-224, 1985 WHOI-R-85-018
Gonyaulax tamarensis cyst dynamics were studied in a shallow estuarine embayment and in deeper nearshore waters. In these two locations, the cysts accumulate in basins with other fine particulate materials, they are buried below the sediment surface such that the majority are found in anoxic sediments which can inhibit germination. Their total abundance is very high, and their germination is restricted to surface sediments and therefore is small relative to the number of cells in a bloom. The major differences are in the timing and duration of germination. A tight temporal coupling between excystment and bloom initiation is apparent in the estuary where cysts germinate during a one month interval coinciding with the motile cell bloom. Germination begins at a lower temperature in the deeper coastal waters, precedes the motile cell bloom by several months and lasts eight months in total. The Gulf of Maine is thus seeded by the gradual germination of cysts over many months, providing multiple opportunities for bloom development. In the estuary, bloom success hinges on favorable conditions during a short period of active germination.

Selective Retention of Two Dinoflagellates in a Well-mixed Estuarine Embayment: The Importance of Diel Vertical Migration and Surface Avoidance
Only available on loan from the National Sea Grant Library
Anderson, D.M. and K.D. Stolzenbach
Marine Ecology, Vol. 25, pp. 39-50, 1985 WHOI-R-85-007

Comparison of Toxicity Between Populations of Gonyaulax tamarensis of Eastern North American Waters
Maranda, L., D.M. Anderson, and Y. Shimizu
Estuarine, Coastal and Shelf Science, Vol. 21, pp. 401-410, 1985 WHOI-R-85-011

Sexuality and Cyst Formation in the Dinoflagellate Gonyaulax tamarensis: Cyst Yield in Batch Cultures
Anderson, D.M., D.M. Kulis, and B.J. Binder
J. Phycol., Vol. 20, pp. 418-425, 1984 WHOI-R-84-010

The Abundance and Distribution of the Toxic Dinoflagellate Gonyaulax tamarensis in Long Island Estuaries
Schrey, S.E., E.J. Carpenter, and D.M. Anderson
Estuaries, Vol. 7, No. 4B, pp. 472-477, 1984 WHOI-R-84-018

Importance of Life Cycle Events in the Population Dynamics of Gonyaulax tamarensis

Anderson, D.M., S.W. Chisholm, and C.J. Watras
Marine Biology, Vol. 76, pp. 179-189, 1983 WHOI-R-83-019

Vertical and Horizontal Distributions of Dinoflagellate Cysts in Sediments
Anderson, D.M., D.G. Aubrey, M.A. Tyler, and D.W. Coats
Limnol. Oceanogr., Vol. 27, No. 4, pp. 757-765, 1982 WHOI-R-82-022

Distribution of the Toxic Dinoflagellate Gonyaulax tamarensis in the Southern New England Region
Only available on loan from the National Sea Grant Library
Anderson, D.M., D.M. Kulis, J.A. Orphanos, and A.R. Ceurvels
Estuarine, Coastal and Shelf Science, Vol. 14, pp. 447-458, 1982 WHOI-R-82-005

Regulation of Growth in an Estuarine Clone of Gonyaulax tamarensis Lebour: Salinity-dependent Temperature Responses
Watras, C.J., S.W. Chisholm, and D.M. Anderson
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The Environmental and Climatic Distribution of Dinoflagellate Cysts in Modern Marine Sediments from Regions in the North and South Atlantic Oceans and Adjacent Seas
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The distribution of dinoflagellate cysts in modern marine sediments is of interest for two main reasons. First, it provides specialized marine biological information concerning the biogeography and ecology of the living dinoflagellate species which form resistant encysted stages during their life histories. Second, it represents a major source of information for palynologists who are concerned with dinoflagellate paleoecology and paleoenvironmental research. This study reports on the distribution of dinoflagellate cysts from fourteen regions in the North and South Atlantic Oceans, the Caribbean and Mediterranean Seas, and one area in the southeastern Pacific Ocean near Peru. The four main goals of the study, presented in this paper in detail, were: 1) to analyze the environmental- climatic distribution of extant cyst-based dinoflagellate species in marine sediments; 2) to attempt an ecologic-environmental classification of these taxa on the basis of this analysis; 3) to identify important factors which determine the distribution of these cysts in modern sediments; and 4) to provide a quasi- theoretical model to account for the observed distribution of cysts which will be useful in the future development of paleoecological and paleoenvironmental studies with fossil dinoflagellates (cysts).

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