Abbott, I. H. and A. E. von Doenhoff (1980). Theory of wing sections. New York, Dover Publications Inc.

Aderibigbe, O. and N. Rajaratnam (1998). "Effect of sediment gradation on erosion by plane turbulent wall jets." J. Hydraulic Engineering, ASCE. **124**(10): 1034-1042.

Aebi, H. (1974). Catalase. . Methods of Enzymatic Analysis. . H. U. Bergmeyer. London Academic Press**:** 671-684.

Agri.te.co. (1998). " Sperimentazione della gestione dei molluschi bivalvi nei compartimenti di Monfalcone, Venezia e Chioggia. Rapporto finale - Compartimenti di Monfalcone e Venezia." Ricerca Scientifica **4.A.88.**

Albertelli, G., D. Bedulli, C.-V. R., M. Chiantore, S. Giacobbe, S. Jerace, M. Leonardi, F. Priamo, S. Schiaparelli and N. Spanò (1998). "Trophic features of benthic communities in the Northern Adriatic Sea." Biol. Mar. Medit. **5**: 136-143.

Aleffi, F., G. Della Seta, F. Goriup, P. Landri and G. Orel (1998). Fattori climatici ed edafici e popolamenti bentonici dell'Adriatico settentrionale e del Golfo di Trieste. In Evoluzione dello stato trofico in Adriatico: analisi degli interventi attuati e future linee di intervento. Marina di Ravenna, Regione Emilia-Romagna, Provincia di Ravenna, Autorità di bacino del fiume Po.

Alexander, K. M. (1993). "Biochemical investigations on edible molluscs of Kerala. 1. A study on the nutritional value of some bivalves." Fish Technol, Cochin **9**(1): 42-47.

Ali, K. H. M. and A. A. Salehi Neyshaboury (1991). "Localised scour downstream of a deeply submerged horizontal jet." Proc. Inst. Civ. Engngs. Part 2, **91**: 1-18.

Allen, J. and M. Leeder (1980). "Criteria for the instability of upper stage plane beds." Sedimentology, **27**: 209-217.

Aller, R. C., J. Y.Yingst, J. Y. (1980). "Relationships between microbial distributions and the anaerobic decomposition of organic matter in surface sediments of long Island Sound, USA." Mar. Biol **56**(29-42).

Allison, E. H. (1993). The dynamics of exploited populations of scallops (*Pecten maximus* L.) and queens (*Chlamys opercularis* L.) in the North Irish Sea, University of Liverpool.

Allison, E. H. and A. R. Brand (1995). "A mark-recapture experiment on queen scallops, Aequipecten opercularis, on a North Irish Sea fishing ground." Journal of the Marine Biological Association of the United Kingdom **75**: 323-335.

Allison, E. H., A. R. Brand and E. J. Murphy (1989). Mortality rates in North Irish Sea Pecten maximus, from tagging experiments. 7th International Pectinid Workshop, Portland, Maine.

Allison, E. H., U. A. W. Wilson and A. R. Brand (1994). "Age determination and the first growth ring in North Irish Sea populations of the scallop, *Pecten maximus* (L.)." Journal of Molluscan Studies **60**: 91-95.

Alvarez, M. R. and F. E. Friedl (1992). "Effects of fungicide on in vitro hemocyte viability, phagocytosis and attachment in the American oyster, *Crassostrea virginica*." Aquaculture **107**: 135-140.

Alves, F., L. Chícharo, A. Nogueira and J. Regala (in press). "Changes in benthic communities due to clam dredging in the Algarve coast (South Portugal): importance of seasonal analysis for short-term impact studies." Journal of the Marine Biological Association of the United Kingdom.

Ambrogi, R., P. Fontana, I. Sala (1997). "Reclutamento di *Chamelea gallina* (L.) in un'area antistante il Delta del Po in relazione al macrobenthos." Biologia Marina Mediterranea **4**(1): 182-187.

Amirthalingam, C. (1928). "On lunar periodicity in reproduction of *Pecten opercularis* near Plymouth in 1927-1928." Journal of the Marine Biological Association of the United Kingdom **15**: 605-641.

Anger, K. and H. J. Hirche (1990). "Nucleic acids and growth of larvae and juvenile spidercrab, *Hyas araneus*." Mar. Bio **705**: 403-411.

Anon (1992). Ground system locates scallops - off coast of Canada. Fishing News International, July 1992.

Anschutz, A., S. Zhong, B. Sundby, A. Mucci and C. Gobeil (1998). "Burial efficiency of phosphorus and the geochemistry of iron in continental margin sediments." Limnol. and Oceanogr **43**(1): 53-64.

Ansell, A. D. (1978). Storage and utilisation of reserves in Pectinid bivalves with particular reference to the adductor muscle. Scallop workshop, Brest, France, 8th - 13th May 1978.

Ansell, A. D., J. C. Dao, A. Lucas, L. A. Mackie and C. p. Morvan (1988). Reproductive and genetic adaptation in natural and transplant populations of the scallop, *Pecten maximus*, in European waters. Report to the European Commission on research carried out under EEC Scientific Co-operation Contract No. ST2J-0058-1-UK (CD).

Ansell, A. D., J. C. Dao and J. Mason (1991). Three European scallops: *Pecten maximus*, *Chlamys (Aequipecten) opercularis* and *C. (Chlamys) varia*. Scallops: biology, ecology and aquaculture. S. E. S. (ed.). Amsterdam, Elsevier**:** 715-751.

Antoine, L., P. Arzel, A. Laurec and E. Morize (1979). "La croissance de la coquille Saint-Jaques (*Pecten maximus* (L.)) dans les divers gisements francais." Rapport et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la mer **175**: 85-90.

Aravindakshan, I. (1955). Studies on the biology of the queen scallop, Chlamys opercularis (L.). University of Liverpool.

Arntz, W. E. and W. Weber (1970). "*Cyprina islandica* L.. (mollusca, Bivalvia) als

Nahrung von Dorschg und Kliesche in der Kieler Bucht." Ber Deut Wissen Komm Meeresforschung **21**: 193-205.

Aschan, M. M. (1991). "Effects of Iceland scallop dredging on benthic communities in the Northeast Atlantic. Special international workshop on the effects of physical disturbance on the sea floor on benthic and epibenthic ecosystems."

Atema, J. (1988). Distribution of chemical stimuli, In: Atema, J., Popper, A.N., Fay, R.R., Tavolga, W.N. (eds.) Sensory biology of aquatic animals, Springer-Verlag, New York.

Atkinson, D. E. (1968). "The energy charge of the adenylate pool as a regulatory parameter. Interaction with feedback modifiers." Biochemistry **7**: 4030-4034.

Atkinson, D. E. (1972). The adenylate energy charge in metabolic regulation Horizon of Bioenergetics A. San Pietro and Gest (eds), Academic Press, New York and London.**:** 83

Atkinson, D. E. (1977). Cellular Energy Metabolism, , Academic Press, New York.

Auffret, M. (1985). Morphologie comparative des types hemocytaires chez quelques mollusques bivalves d'interet commercial. , Universitè de Bretagne Occidentale, Brest, France.

Auffret, M. (1989). "Comparative study of the hemocytes of two oyster species: the European flat oyster, *Ostea edulis* (Linnaeus) and the pacific oyster, *Crassostrea gigas* (Thunberg)." J Shellfish Res **8**: 367-373.

Auffret, M. and R. Oubella (1995). Cytological and cytometric analysis of bivalve mollusc hemocytes SOS Publications, Fair Haven, NJ, USA, .

Baba, J. and P. Komar (1981). "Measurements and analysis of settling velocities of natural quartz and sand grains." J. Sediment. Petrol., **51**: 631-640.

Backeljiau, T., P. Bouchet, S. Gofas and L. de Bruyn (1994). "Genetic variation, systematic and distribution of the venerid clam Chamelea gallina." J. Mar. Biol. Ass. U.K. **74**: 211-223.

Backhaus, J. O. (1985). "A three-dimensional model for the simulation of shelf-sea dynamics." Deutsche Hydrographische Zeitschrift **38**: 165-187.

Backhaus, J. O. and D. Hainbucher (1987). A finite difference circulation model for shelf seas and its application to low frequency variability on the North European shelf. In: Three dimensional models of marine and estuarine dynamics. Amsterdam, Elsevier.

Baird, R. H. and F. A. Gibson (1956). "Underwater observations on scallop (*Pecten maximus* L.) beds." Journal of the Marine Biological Association of the U.K **35**: 555-562.

Ball, B., B. Murday and I. Tuck (2000). Effects of the otter trawling on the benthos and environment in muddy sediments. in The Effects of Fishing on Non-target Species and Habitats. M. J. Kaiser and d. G. S. J. Oxford, Blackwell Science**.:** Pags 69-82.

Ballarin, L., F. Cima and A. Sabbadin (1994). "Phagocytosis in the colonial ascidian *Botryllus schlosseri*." Develop. Comp. Immunol. **18**: 467-481.

Ballarin, L., P. D and M. G. Marin (In prep). "Mechanical disturbance affects haemocyte functionality in the Venus clam *Chamelea gallina*." Comp. Biochem. Physiol.

Banse, K. (1982). " Mass-scale rates of respiration and intrinsic growth in very small invertebrates." Marine Ecology Progress Series **9**: 281-297.

Barbeau, M. A. and H. Caswell (1999). "A matrix model for short-term dynamics of seeded populations of sea scallops." Ecological Applications **9**(1): 266-287.

Recently, there has been increasing interest in releasing ("seeding") bivalves onto the seabed for purposes of aquaculture or population enhancement. The success of such enterprises has varied greatly and is related to the interactions between mortality, dispersal, and growth of the organisms. In this paper, we have constructed a stage-based matrix model for short-term population dynamics of seeded sea scallops (Placopecten magellanicus). Our goals were to predict scallop survival to commercial size and to determine the relative contributions of predation, dispersal, and growth to loss of scallops. Competing risk theory was used to account for predation by crabs and by sea sears, and for correlations between dispersal and predation (both of which depend on encounters with predators). Density dependence tin the form of predator functional responses), seasonal variation, and a simple spatial structure were also incorporated into the model. The model was parameterized from the results of small-scale experiments and tested against independently observed population trajectories. Uncertainty analysis was used to determine the effect of parameter sampling error on model output. Sensitivity analysis indicated that variables affecting predation by crabs were important and that variables affecting intermediate-sized scallops (e.g., large juveniles) were more important than those affecting other size classes. Using perturbation analysis, we ranked alternative management scenarios for increasing final scallop survival from the most effective to the least effective as follows: reducing predator densities, increasing size of seeded scallops, changing the initial density of seeded scallops, increasing the dimensions of the site, and changing the season of seeding. Inclusion of seasonal variability in predator densities (thereby converting the deterministic model into a stochastic model) did not greatly change final scallop survival.

Barber, B. J. and N. J. Blake (1991). Reproductive physiology. In: Scallops: biology, ecology and aquaculture. New York, Elsevier.

Barillari, A., A. Boldrin, C. Mozzi and S. Rabitti (1978). "Alcune relazioni tra natura dei sedimenti e presenza della vongola Chamelea gallina, nell'Alto Adriatico, presso Venezia." Atti Ist. Veneto Sci. Lett. Arti, cl.sci.fis.,mat.nat **137**: 19-34.

Barracco, M. A., I. D. Medeiros and F. M. Moreira (1999). "Some haemato-immunological parameters in the mussel *Perna perna*." Fish Shellfish Immunol **9**: 387-404.

Barthel, D. (1984). "On the ecophysiology of the sponge *Halichondria panicea* in Kiel

Bight. Substrate specificity, growth and reproduction." MAR. ECOL. PROG. SER. **32**(2-3): 291-298.

Barton, B. A., C. B. Schreck and L. A. Sigismondi (1986). "Multiple acute disturbances evoke cumulative physiological stress responses in juvenile chinook salmon." Transactions of the American Fisheries Society **115,**: 245-251.

Bayne, B. L., R. F. Addison, J. M. Capuzzo, K. R. Clarke, J. S. Gray, M. N. Moore and R. M. Warwick (1988). "An overwiew of the GEEP Workshop " Mar. Ecol. Prog. Ser. **46** 235-243.

Bayne, B. L., A. D. Brown, K. Burns., D. R. Dixon, A. Ivanovici, D. R. Livingstone, D. M. Lowe, M. N. Moore, A. R. D. Stebbing and J. Widdows (1985). The effects of stress and pollution in marine animals. . New York, Praeger Publishers.

Bayne, C. J., M. N. Moore, T. H. Carefoot and R. J. Thompson (1979). "Hemolymph functions in *Mytilus californianus* The cytochemistry of hemocytes and their responses to foreign implants and hemolymph factors of phagocytosis." J Invertebr Pathol **34**: 1-20.

Beckmann, N., M. P. Morse and C. M. Moore (1992). "Comparative study of phagocytosis in normal and diseased hemocytes of the bivalve mollusc *Mya arenaria*." J. Invertebr. Pathol. **59,**: 124-132..

Bemvenuti, C. E. (1994). "O poliqueta Nephtys fluviatilis Monro, 1937, como predador da infauna na comunidade de fundos moles." **Atlântica Rio Grande**(16): 87-98.

Beninger, P. G. and A. Lucas (1984). "Seasonal variations in condition, reproductive activity and gross biochemical composition of two species of adult clam reared in a common habitat: Tapes decussatus L. (Jeffreys) and Tapes philippinarum (Adams and Reeve)." J. Exp. Mar. Biol. Ecol. **79**: 19-37.

Benitez-Nelson, C. R. (2000). "The biochemical cycling of phosphorus in marine systems." Earth-Science Reviews **51**: 109-135.

Bergman, M. J. N., M. Fonds, M. Hup, M. Lewis, van der Puyl, A. Stam and D. Uyl (1990). Direct effects of beamtrawl fishing on benthic fauna in the North Sea - a pilot study. Effects of beam trawl fishery on the bottom fauna of the North Sea, BEON-rapport, 8: 33-57. **II**.

Bergman, M. N. J. and M. Hup (1992). "Direct effects of beam trawling on macrofauna in sandy bottom sediment in the southernb North Sea." ICES J. Mar. Sci **49**: 5-11.

Berner, R. A. (1980). "Early diagenesis - A theoretical approach." *University press, Princeton Series in Geochemistry*: 241p.

Berthou, P. (1984). "Gestion rationelle des stocks de praires sur la côte Ouest du Cotentin." Comité local des pêches de Granville.

Beukers-Stewart, B. D., S. R. Jenkins and A. R. Brand (2001). "The efficiency and

selectivity of spring-toothed scallop dredges: A comparison of direct and indirect methods of assessment." Journal of Shellfish Research **20**(1): 121-126.

The efficiency and selectivity of spring-toothed scallop dredges was assessed using a concurrent depletion experiment and diver survey of dredge tracks on a north Irish Sea fishing ground. Two size classes of the scallop, Pecten maximus (L. 1758), were examined: below minimum legal landing size (MLLS), (90-109 mm shell length (SL)) and above MLLS (> 109 mm SQ. Estimates of efficiency from the depletion experiment (24.3% and 29.5% respectively) were consistently lower than those from the diver surveys (38.0% and 40.7% respectively). This difference appeared to be due to inherent variation in the efficiency of scallop dredges rather than bias from either technique. This emphasizes the need for error terms to be built into estimates of dredge efficiency. The diver survey also found that dredges were highly selective toward scallops greater than 90 mm SL, catching only 3.0% or less of individuals below this size. Consequently, the diver survey provided a much more accurate assessment of scallop size and age composition than dredge surveys. Dredge efficiency was also assessed for four species of benthic fauna commonly taken as by-catch in the local fishery. Estimates of efficiency from the depletion experiment were found to include a considerable amount of indirect fishing mortality. When efficiency was defined as total mortality due to fishing (the combination of catch and indirect fishing mortality), estimates from the depletion experiment and diver surveys were in close agreement. For two species, Luidia ciliaris (Phillipi 1837) and Cancer pagurus (L. 1758), these efficiency or total mortality estimates were approximately 45% and 68% respectively, emphasizing the impact scallop dredging might have on non- target species. In summary, we recommend that if possible, depletion experiments should be combined with diver surveys when assessing scallop dredge performance. Diver surveys provided additional information on dredge selectivity along with an improved measure of the variance in dredge efficiency estimates.

Bitensky, L., R. S. Butcher and J. Chayen (1973). Quantitative cytochemistry in the study of lysosomal function. . Lysosomes in biology and pathology. . J. T. Dingle. Amsterdam, , Elsevier, . **465-510.**

Black, K. P. and G. D. Parry (1994). "Sediment transport rates and sediment disturbance due to scallop dredging in Port Phillip Bay." Memoirs of the Queensland Museum **36**(2): 327-341.

Bombace, G. (1991). Fisheries of the Adriatic Sea. In: Marine Eutrophication and Population dinamics. 25th European Marine Biology Symposium, Università di Ferrara.

Bombace, G. (1992). Fisheries of the Adriatic Sea.In Marine eutrophication and population dynamics, Colombo G., I. Ferrari, V.U. Ceccherelli, R. Rossi (Eds),. 25th European Marine Biology Symposium, Olsen & Olsen, Fridengburg- Denmark.

Bonvicini Pagliai, A. M., A. M. Cognetti Varriale, R. Crema, M. Curini Galletti and R. Vandini Zunarelli (1985). "Environmental impact of exstensive dredging in a coastal marine area." Marine Pollution Bulletin **16**: 483-488.

Boon, G. C. A., Duineveld, E.M., Berghuis, E.M., Van der Wele, J.A. (1998). "Relationship between activity and the annual phytopigment cycle in near-bottom water

and sediments North Sea." Estuar. Coast. and Shelf Sci **46**: 1-13.

Bord Iascaigh Mhaire, B. (1998). Irish Food - Seafood Edition. A publication produced by BIM.

Borgers, M. and A. Verheyen (1985). "Enzyme cytochemistry " Int Rev Cytol **95** 163-227.

Boucher, J. and S. Fifas (1995). "Dynamique de la population de coquilles Saint-Jacques (Pecten maximus) de la rade de Brest : Hier etait-il different d'aujourd'hui?" Communaute Urbaine de Brest /IFREMER, Prog. Rade, Rencontres scientifiques internationales, Brest (France), **3**: 2-14.

Bourne, N. (1964). "Scallops and the offshore fishery of the Maritimes." Bulletin of the Fisheries Research Board of Canada **145**: 1-60.

Bourne, N. (1966). "Relative efficiency and selection of three types of scallop drags." ICNAF Research Bulletin **3**(1): 5-25.

Boyden, C. R. (1971). "A comparative study of the reproductive cycles of the cockles *Cerastoderme edule* and *C. glaucum*." J. Mar. Bio. Ass. U.K. **51**: 605-622.

Bradshaw, C., L. O. Veale and A. R. Brand (2002). "The role of scallop-dredge disturbance in long-term changes in Irish Sea benthic communities: a re-analysis of an historical dataset." Journal of Sea Research **47**(2): 161-184.

Benthic community data collected between 1938 and 1950 by N.S. Jones were compared with modem samples from seven sites in the Irish Sea. Multivariate and univariate methods were used to compare community change over time and examine the possible impact of scallop dredging over the 60 year time period. A conservative approach to data analysis ensured that observed differences in faunal composition between time periods were not due to differences in sampling methodologies or taxonomic identification. The community composition changed at all sites, though to different degrees. The amount of change was related to how, long a site had been fished, rather than fishing intensity. Mobile, robust and scavenging taxa have increased in abundance, while slow-moving or sessile, fragile taxa have decreased. Differences between historical and modem samples were greater than could be accounted for by the natural variability, of the system (as indicated by spatial and temporal replication at three sites) and indicate real long- term change. This study emphasises that. in the absence of good-quality data series and experiments, the use of 'fuzzy' historical data is often the only possible way to judge long- term change and can yield valuable results. (C) 2002 Elsevier Science B.V All rights reserved.

Bradshaw, C., L. O. Veale, A. S. Hill and A. R. Brand (2000). The effects of scallop dredging on gravelly sea-bed communities. Effects of Fishing on Non-Target Species and Habitats. M. J. Kaiser and S. J. de Groot. Oxford, Blackwell Science**:** 83-104.

Gravelly sea-bed communities around the Isle of Man, Irish Sea, are very heterogeneous in terms of both epi- and infauna. This patchiness is found at a wide range of spatial scales. This paper reviews the results of a large study which investigates disturbance by scallop dredging from the large- (fishing grounds) to the small-scale (experimental plots).

- Commercial dredging for scallops and queen scallops disturbs, and may be a factor in structuring, benthic communities on these gravelly substrata.
- Community composition can be shown to be related to the intensity of commercial dredging effort; this is confirmed by dredging experiments in an area closed to commercial fishing.
- The effect of scallop dredge disturbance on gravelly sea-beds may differ from that of bottom fishing on other soft sediments due to the extreme patchiness of animal distribution, greater abundance of epifauna and to the combined effect of the heavy, toothed scallop gear and stones caught in the dredges.
- The underlying patchiness of gravelly bottom benthos necessitates the study of dredge disturbance on many spatial scales and with a high degree of replication

Bradshaw, C., L. O. Veale, A. S. Hill and A. R. Brand (2001). "The effect of scallop dredging on Irish Sea benthos: experiments using a closed area." Hydrobiologia **465**(1-3): 129-138.

A 2 km(2) area off the southwest coast of the Isle of Man (Irish Sea) has been closed to commercial fishing with mobile gear since March 1989. This area was heavily fished for Pecten maximus (Linnaeus, 1758) prior to closure, and the seabed immediately surrounding the closed area is still one of the most heavily dredged in the Irish Sea. Two methods have been used to study the effect of scallop dredging on the benthos in this closed area and adjacent fished areas. Firstly, twice- yearly grab sampling of experimental plots inside and outside the closed area since 1995 has enabled comparisons of the benthic infauna and epifauna of experimentally dredged plots, undredged control plots and plots exposed to commercial dredging. Secondly, divers have carried out visual transect surveys of P. maximus numbers regularly since closure. Communities of experimentally disturbed plots have become less similar to adjacent undisturbed control areas and more similar to commercially dredged areas. At each sampling date, similarity between dredged samples was greater than between undredged samples. Since 1989, there have been increases in the mean numbers of P. maximus in the closed area. The age structure of the closed area P. maximus population is also different to that outside, with a higher mean age due to the presence of large, old individuals. These results present strong evidence that scallop dredging alters benthic communities and suggest that the closure of areas to commercial dredging may allow the development of more heterogeneous communities and permit the populations of some species to increase. A common problem with studying fishing disturbance is the lack of good control sites and this work also demonstrates the value of closed areas to scientific studies of demersal fishing.

Bradstock, M. and D. P. Gordon (1983). "Coral - like bryozoan growths in Tasman Bay and their protection to conserve fish stocks." New Zealand Journal of Marine and Freshwater Research **17**: 159-163.

Braga, G. and A. Stefanon (1969). " Beachrock e Alto Adriatico: aspetti paleografici, climatici, morfologici, ed ecologici del problema." Atti Ist. Veneto Sci. Lett. Arti, **127**: 351-366.

Brambati, A. (1987). "Regime, bilancio sedimentologico ed ipotesi di ripascimento dei lidi di Venezia." Atti del VI Congresso Nazionale dell'Ordine dei Geologi(153-209).

Brambati, A. (1992). Origin and evolution of the Adriatic Sea. Fredensborg, Olsen &

Olsen,.

Brambati, A., M. Ciabatti, G. P. Fanzutti, F. Marabini and R. Marocco (1983). "A new sedimentological textural map of the Northern Adriatic Sea." Boll. Oceanol. Teor. Appl. **1**((4)): 267-271.

Brambati, A. and F. Finocchiaro (1988). "Definizione dei regimi erosivi e deposizionali di un litorale mediante l'analisi della pendenza della spiaggia sottomarina." Atti Ticinesi di Scienze della Terra.: 469-491.

Brambati, A. and G. Fontolan (1990). "Sediment resuspension induced by clam fishing with hydraulic dredges in the Gulf of Venice (Adriatic Sea). A preliminary experimental approach." Bollettino Di Oceanologia Teorica ed Applicata **Vol. VIII**(2): 113-121.

Brambati, A. and G. Fontolan (1992). "Abrasion of beach sands: a laboratory predictive model for Northern Adriatic Sea beaches." Boll. Oceanol. Teor. Appl. **X**(2-3-4).

Brambati, A. and R. Marocco (1983). "Dispersion and sedimentation of industrial waste of bauxite, blendes, fluorites and phosphorites dumped in the Gulf of Venice, Italy." Boll. Oceanol. Teor. Appl. **I**(3).

Brambati, A. and G. Venzo (1967). "Recent sedimentation in the Northern Adriatic Sea between Venice and Trieste." Studi Trentini di Scienze Naturali **XLIV**(2): 202-274.

Brand, A. R. (1991). Scallop ecology: distributions and behaviour. Scallops: Biology , ecology and aquaculture. S. Shumway. Amsterdam, Elsevier**:** 517-584.

Brand, A. R. (2000). "North Irish Sea scallop (*Pecten maximus* and *Aequipecten opercularis*) fisheries: effects of 60 years of dredging on scallop populations and the environment." Alaska Department of Fish and Game, Special Publication **14**: 37-43.

Brand, A. R. and E. H. Allison (1987). The Isle of Man fishery for the queen scallop, Chlamys opercularis. 6th International Pectinid Workshop, Menai Bridge, Wales.

Brand, A. R., E. H. Allison and E. J. Murphy (1991). North Irish Sea scallop fisheries: a review of changes. An international compendium of scallop biology and culture. S. E. Shumway and P. A. Sandifer. Baton Rouge, World Aquaculture Society**:** 204-218.

Brand, A. R. and B. D. Beukers-Stewart (2002). Shellfish Research Report to the Isle of Man Government, Department of Agriculture, Fisheries and Forestry, June 2002, Port Erin Marine Laboratory, University of Liverpool

Brand, A. R. and D. J. Morris (1984). "The respiratory responses of the dog cockle *Glycymeris glycymeris* (L.) to declining environmental oxygen tension." J. Exp. Mar. Biol. Ecol. **83**: 89-106.

Brand, A. R. and E. J. Murphy (1985). Estimation of mortality rates by a mark, release, recapture experiment for the Isle of Man scallop stocks. 5th International Pectinid Workshop, La Coruña, Spain.

Brand, A. R. and E. J. Murphy (1992). "A tagging study of North Irish Sea scallop

(*Pecten maximus*) populations: comparisons of an inshore and an offshore fishing ground." Journal of Medical and Applied Malacology **4**: 153-164.

Brand, A. R., J. D. Paul and J. N. Hoogesteger (1980). "Spat settlement of the scallops *Chlamys opercularis* (L.) and *Pecten maximus* (L.) on artificial collectors." Journal of the Marine Biological Association UK **60**: 379-390.

Brand, A. R. and K. L. Prudden (1997). The Isle of Man scallop and queen fisheries: past, present and future, Report to Isle of Man Department of Agriculture, Fisheries and Forestry by Port Erin Marine Laboratory, University of Liverpool

Brand, A. R., U. A. W. Wilson, S. L. Hawkins, E. H. Allison and N. A. Duggan (1991). "Pectinid fisheries, spat collection and the potential for stock enhancement in the Isle of Man." ICES Marine Science Symposium **192**: 79-86.

Bray, J. B. and J. T. Curtis (1957). "An ordination of the upland forest communities of the Southern Wisconsin." Ecol. Monograph **27**: 325-349.

Brett, J. R., J. E. Shelbourn and C. T. Shoop (1969). "Growth rate and body composition of fingerling sockeye salmon, *Oncorhynchus nerka*, in relation to temperature and ration size." J. Fish. Res. Bd Can. , **26**: 2363-2394.

Breum, J. (1970). "Optimum growth medium and kinetics determination for use in recombinant protein and enzyme preparation." APPLIED MICROBIOLOGY AND BIOTECHNOLOGY **58**(4): 495-502.

Bridge, J. P. (1972). "Some observations on the penetration into the sea bed of tickler chains on a beam trawl." International council for the exploration of the sea CM 1972/ **B:7**: 9pp.

Briggs, R. P. (1991). A study of the Northern Ireland fishery for the escallop Pecten maximus (Linnaeus 1758). In: An international compendium of scallop biology and culture, Baton Rouge.

Briggs, R. P. (1995). A review of research on the Northern Ireland scallop stocks. 10th International Pectinid Workshop, Cork, Ireland.

Brokordt, K. B., H. J. H and H. E. Guderley (2000). " Effects of reproduction on escape response and muscle metabolic capacities in the scallop *Chlamys islandica* Müller 1776." J. Exp. Mar. Biol. Ecol. **251**: 205-225.

Brooks, S. P. J., A. De Zwaan, G. Van den Thillart, O. Cattani and S. K.B (1991). "Differential survival of *Venus gallina* and *Scapharca inaequivalvis* during anoxic stress: Covalent modification of phosphofructokinase and glycogen phosphorylase during anoxia." J. Comp. Physiol. **161B, 207-212.**

Brown, R. A. (1989). Bottom trawling in Strangford Lough: Problems and policies. 3rd North Sea Seminar.

Brown, S. K., P. J. Auster, L. Lauck and M. Coyne (1998). Ecological Effects of Fishing.

NOAA's State of the Coast Report. :. Silver Spring, MD, NOAA

Brylinsky, M., J. Gibson and D. C. Gordon (1994). "Impacts of flounder trawls on the intertidal habitat and community of the Minas Basin, Bay of Fundy." Can J Fish Aquat Sci **51**: 650-661.

Buchanan, J. B. (1984). Sediment aalysis. Methods for the study of marine benthos, IBP Handbook 16. H. N.A and M. I. A.D. Oxford, Blackwell**:** 41-65.

Buckley, L. (1984). "RNA/DNA ratio: an index of larval fish growth in the sea." Mar. Biol. **80**: 291-298.

Bucqoy, E., Dautzenberg, P., Dollfus, G. (1882-1898). "Les mollusques marins du Rousillon. Tome 2, Pelecypodes." *J. Baillière & Fils*, Paris: 884pp.

Buestel, D., Dao J.C., Gohin F. (1985). "Estimation d'un stock naturel de coquilles Saint-Jacques par une méthode combinant les dragages et la plongée. Traitement des résultats par une approche géostatistique." ICES, Theme X: 33p.

Buhs, F. and K. Reise (1997). "Epibenthic fauna dredged from tidal channels in the Wadden Sea of Schleswig-Holstein: spatial patterns and a long-term decline." Helgolander Meeresuntersuchungen **51**(3): 343-359.

The epibenthic fauna dredged in the channels of the Wadden Sea of Schleswig-Holstein is dominated by crustaceans. Mean species richness is lower in a southern region (7.6 +/- 2.2 species haul(-1)) which is part of the Elbe estuary and lacks protective barrier islands. A northern region is more marine and is protected by a seaward barrier of high sands and islands. Here mean species richness is 10.9 +/- 2.8. Within channels, there is no significant inshore-offshore gradient, and species number does not increase with depth. Stratified sampling near the island of Sylt revealed that abundance and diversity are high along the gentle upper slope (5 m depth) of channels when mussels are present, but low in the absence of mussels. Abundance and diversity are also low along the steeper slope below (at 10 and 15 m depth). In a channel with scattered stones and boulders, highest diversity (16.0 +/- 5.1) and dense epibenthic assemblages were encountered along the upper and middle slopes (5 and 10 m). Comparisons with historical surveys suggest that a decline of nearly fifty per cent of all epifaunal species within the last hundred years may be attributed to fishery disturbances.

Bullimore, B. (1985). "An investigation into the effects of scallop dredging within the Skomer Marine Reserve, Skomer Marine Reserve Subtidal Monitoring Project." 29pp.

Bullow, F. J., M. E. Zeman, J. R. Winningham and W. F. Hudson (1981). "Seasonal variations in RNA/DNA ratios and in indicators of feeding, reproduction, energy storage, and condition in a population of bluegill, *Lepomis macrochirus* Rafinesque." J. Fish. Biol. , **18**: 237-244.

Bulow, J. F. (1970). "RNA-DNA ratios as indicators of recent growth rates of fish." J. Fish. Res. Bd. Canada **27**: 2343-2349.

Burnell, G. M. (1983). Growth and reproduction of the scallop *Chlamys varia* (L.) on the

west coast of Ireland, National University of Ireland, Galway.

Burnell, G. M. (1991). Annual variations in the spawning and settlement of the scallop *Chlamys varia* (L.) on the west coast of Ireland. An international compendium of scallop biology and culture. S. E. Shumway and P. A. Sandifer. Baton Rouge, World Aquaculture Society**:** 47-59.

Burnell, G. M. and J. Slater (1989). Scallop culture in Ireland: fact or fantasy? 7th International Pectinid Workshop. Portland, Maine.

Burns, D., T. Egan, E. Seward and K. S. Naidu (1995). Identification of scallop beds using an acoustic ground discrimination technique. 10th International Pectinid Workshop, Cork, Ireland, April 26-May 2, 1995.

Burstone, M. S. (1962). Enzyme histochemistry and its application in the study of neoplasms. , New York, London, Academic Press.

Butcher, T., J. Matthews, J. Glaister and G. Hamer (1981). "Study suggests scallop dredges causing few problems in Jervis Bay." Aust. Fish. **40**(9): 9-12.

A marked increase in scallop dredging has recently occurred in Jervis Bay, New South Wales, and implications made that the dredges destroy weed beds leaving a trail of dead or badly damaged scallops. Investigations were conducted by New South Wales State Fisheries biologists and it was found that damage to the seafloor was minimal and temporary. The scallop population structure seems unchanged compared with 1970-71 data. However, there is little doubt that some scallops are damaged by the passage of the dredges, but in some cases this is simply due to the dredges being towed too fast. The ratio of damaged to undamaged scallops is small.

Byers, S. C., Mills, E.L., Stewart, L. (1978). "A comparison of methods of determining organic carbon in marine sediments, with suggestions for a standard method." Hydrobiologia **58**: 43-47.

Caddy, J. F. (1968). "Underwater observations on scallop (*Placopecten magellanicus* L.) behaviour and drag efficiency." J. Fish. Res. Board Can **25**: 2123-2124.

Caddy, J. F. (1971). "Efficiency and selectivity of the Canadian offshore scallop dredge." ICES C.M **1971/K:25**.

Caddy, J. F. (1972). "Size selectivity of the Georges Bank offshore dredge and mortality estimate for scallop from the northern edge of Georges in the period June 1970 to 1971." ICNAF Redbook, Part III: 79-85.

Caddy, J. F. (1973). "Underwater observations on tracks of dredges and trawls and some effects of dredging on scallop ground." Journal of Fisheries Research Board on Canada **30**: 173-180.

Caddy, J. F. (1979). "Long-term trends and evidence for production cycles in the Bay of Fundy scallop fishery." Rapport et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la mer **175**: 97-108.

Caddy, J. F. (1988). A perspective on the population dynamics and assessment of

scallop fisheries, with special reference to the sea scallop *Placopecten magellanicus* Gmelin. Marine Invertebrate Fisheries: their assessment and management. J. F. Caddy, Wiley**:** 559-589.

Cajaraville, M. P., l. S. G. Pa and Y. Robledo (1995). "Light and electron microscopial localization of lysosomal acid hydrolases in bivalve haemocytes by enzyme cytochemistry " Acta Histochem Cytoc **28** (5): 409-416.

Cajaraville, M. P. and S. G. Pal (1995). "Morphofunctional study of the haemocytes of the Bivalve Mollusc *Mytilus galloprovincialis* with emphasis on endolysosomal compartment." Cell Struct Funct **20**: 355-367.

Caldarone, E. M. and L. J. Buckley (1991). "Quantification of DNA and RNA in crude tissues extracts by flow injection analysis." Anal. Biochem. **199**: 137-141.

Calow, P. (1985). Adaptive aspects of energy allocation. Fish energetics: new prespectives. P. Tyler and P. Calow. Maryland, John Hopkins University Press**:** 13-32.

Carballal, M. J., C. Lopez, C. Azevedo and A. Villalba (1997). "Enzymes involved in defence function of haemocytes of mussel *Mytilus galloprovincialis*." J Invertebr Pathol **70**: 96-105.

Carballal, M. J., C. Lopez, C. Azevedo and A. Villalba (1997). "Hemolymph cell types of the mussel *Mytilus galloprovincialis*." Dis Aquat Org **29**: 127-135.

Carbognin, L. and F. Marabini (1987). " Evoluzione recente nel settore costiero veneziano." Pubblicazione eseguita nell'ambito del Progetto Strategico 1987 Oceanografia e Tecnologia Marina, U.O. CNR "Processi Costieri".(.): 9-15.

Casellato, S., F. Bianchi, F. Acri, A. Boldrin, G. Campi, S. Masciadri, L. Masiero, L. Da Ros and M. G. Marin (in prep). "Ecological disturbance of clam dredging in the north-western Adriatic coasts." Fisheries Research.

Casellato, S., G. Campi, S. Masciadri and L. Masiero (2001). Impatto della pesca con draghe idrauliche sulla comunità bentonica della fascia costiera alto-adriatica. XXXII Congresso della Società Italiana di Biologia Marina (S.I.B.M.), Numana.

Casellato, S., G. Campi, S. Masciadri and L. Masiero (2002). " Impact of the hydraulic dredge on the benthic community of the north-western Adriatic coasts." Biol.Mar.Medit. **9**(1): 170-179.

Cassellato, S., F. Bianchi, F. Acri, A. Bolderin, G. Campi, S. Masciadri, L. Masiero, L. Da Ros and M. G. Marin (2001). The impact of clam dredging in the Northern Adriatic coasts: ecological disturbance and subsequent recovery of the seabed., Maò-Menorca.

Ceccarelli, P., C. Costa, A. Letardi, L. Morresi, P. Orecchia, E. Rambaldi and L. Volterra (1988). "Indagine sui molluschi bivalvi di interesse commerciale (telline, vongole, canolicchi) delle coste della Toscana del Lazio e della Campania." Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano per la pesca e l'acquacoltura **1**: 421-478.

Ceccherelli, V. U. (1985). "Ruolo dei bivalvi nella fascia costiera Adriatica." Nova Thalassia **7**(3): 311-336.

Chapman, C. J. (1981). "The swimming behaviour of queens in relation to trawling." Scottish Fisheries Bulletin **46**: 7-10.

The efficiency of fishing gear is assessed in relation to queens (Chlamys opercularis) behaviour. Divers observed queens' swimming behaviour during trawling and suggest that they are able to detect the approaching gear well in advance. They move in short bursts of swimming but after 7 or 8 bursts become exhausted.

Chapman, C. J., J. Main, T. Howell and G. I. Sangster (1979). "The swimming speed and endurance of the queen scallop *Chlamys opercularis* in relation to trawling." Progress in Underwater Science: 57-72 (new series).

Chapman, C. J., J. Mason and J. A. M. Kinnear (1977). Diving observations on the efficiency of dredges used in the Scottish fishery for the scallop, *Pecten maximus* (L.). Aberdeen, Marine Laboratory: Scottish Fisheries Research Report.10

Cheng, T. C. (1976). "Beta-glucuronidase in the serum and hemolymph cells of *Mercenaria mercenaria* and Crassostrea virginica (Mollusca: Pelecypoda)." J Invertebr Pathol **27**: 125-128.

Cheng, T. C. (1981). Bivalves. . Invertebrate Blood Cells R. NA and R. AF, Acad. Press, London, **:** 233-300.

Cheung, S. G. and R. Y. H. Cheung (1995). "Effects of heavy metals on oxygen consumption and ammonia excretion in green-lipped mussels (*Perna viridis*)." Mar. Poll. Bull. **31**(4-12): 381-386.

Chícharo, L. and M. A. Chícharo (1995). "The RNA/DNA ratio as useful indicator of the nutritional condition in juveniles of *Ruditapes decussatus*." Scientia marina. **59, (Suppl. 1)**: 95-101.

Chícharo, L., M. A. Chícharo, F. Alves, A. Amaral, A. Pereira and J. Regala (2001.). "Diel variation of the RNA/DNA ratios in *Crassostrea angulata* (Lamarck) and *Ruditapes decussatus* (Linnaeus 1758) (Mollusca, Bivalvia)." J. Exp. Mar. Biol. Ecol **259**(1): 121-129.

Chícharo, L., M. A. Chícharo, M. Gaspar, F. Alves and J. Regala (2002). "Ecological characterisation of dredged and recently dredge-free areas of a bivalve fishing ground, off South Portugal." Journal of the Marine Biological Association of the United Kingdom. **82**: 41-50.

Chícharo, L., J. Regala, F. Gaspar, F. Alves and M. A. Chícharo (2002.). "Reburial time and indirect mortality of *Spisula solida* clams caused by dredging." Fish. Res. **1379**: 1-11.

Chícharo, L., J. Regala, M. Gaspar, F. Alves and M. A. Chícharo (2002). "Reburial time

and indirect mortality of *Spisula solida* clams caused by dredging." Fisheries Research **59**(1-2): 247-258.

Chícharo, L., J. Regala, M. Gaspar, F. Alves and M. A. Chícharo (2002). "Macrofauna spatial differences within clam dredge-tracks and their implications for short-term fishing effects studies." Fisheries Research **54**(3): 349-354.

Chícharo, L. M., M. A. Chícharo, F. Alves and J. Regala (2000). Ecological analysis of dredge impact on the South of Portugal., Ecodredge Project (FAIR PL- 4465) Interim Report

Chícharo, M. A., A. Amaral, S. Condinho, M. Gaspar and L. Chícharo (in press). "Study of the chronic effects of dredging induced stress on the clam (*Spisula solida*) using nucleic acids and lipids composition." Fisheries Research.

Chícharo, M. A., L. Chícharo, A. Amaral, S. Condinho and M. B. Gaspar (in press). "Adenylic-derived indices and reburying time as indicators of the effects of dredging-induced stress on the clam *Spisula solida*. Marine Biology."

Chopin, F., Y. Inoue and T. Arimoto (1996). "Development of a catch mortality model." Fish. Res. **25**: 377-382.

Chopin, F. S. and T. Arimoto (1995). "The condition of fish escaping from fishing gears - a review." Fisheries Research **21**(3-4): 315-327.

> The capture of immature fish in many commercial fisheries is controlled by restricting the use of fishing gears or elements of fishing gears that prevent the escape of immature fish. Improving the selective characteristics of fishing gear is based on the assumption that fish escaping are not seriously damaged and able to make a complete recovery. If fish escape and die as a direct result of stress and injuries or indirectly due to disease and predation associated with gear damage, then increasing the opportunity for escape by improving selectivity may result in an increased level of unaccounted fishing mortality. This paper identifies the main fishing gear types used for harvesting marine and freshwater fish, a range of injuries, stress reactions and mortalities that can occur during capture and escape. It is concluded that immediate and delayed mortalities can occur in fish escaping from fishing gears and that the high variation in mortality rates within experiments is associated with a lack of information on how fish condition is affected by various fishing stressors and the type and severity of physical damage received. Improving selectivity without reducing damage or stress incurred during capture and escape may not be the most appropriate way of protecting immature fish.

Christensen, B., A. Vedel and E. Kristensen (2000). "Carbon and nitrogen fluxes in sediment inhabited by suspension-feeding (Nereis diversicolor) and non-suspension-feeding (N. virens) polychaetes." Marine Ecology Progress Series **192**: 203-217.

Churchill, J. H. (1989). "The effect of commercial trawling on sediment resuspension and transport over the Middle Atlantic Bight continental shelf." Continental Shelf Research **Vol. 9, No. 9**: pp. 841-846.

Cima, F. and L. Ballarin (1999). "TBT-induced apoptosis in tunicate haemocytes "

Appl. Organomet. Chem. **13**: 697-703.

Cima, F., V. Matozzo, M. G. Marin and L. Ballarin (2000). "Haemocytes of the clam *Tapes philippinarum* (Adams & Reeve, 1850): morphofunctional characterisation." Fish Shellfish Immunol. **10,**: 677-693.

Clarke, K. R. and R. M. Warwick (1994). Changes in marine communities; an approach to statistical analysis and interpretaion. UK, Natural Environment Research Council.

Clemmesen, C. (1994). "The effect of food availability, age or size on the RNA/DNA of individually measured herring larvae: laboratory calibration." Mar. Biol. **118** 377-382.

Coffen-Smout, S. S. and E. I. S. Rees (1999). "Burrowing behaviour and dispersion of cockles *Cerastoderma edule* L. following simulated fishing disturbance." Fisheries Research **40**: 65-72.

Coleman, N. (1981). "Velocity profiles with suspended sediment." J. Hydraul. Res., **19**: 211-229.

Coles, J. A., S. R. Farley and R. K. Pipe (1995). "Alteration of the immune response of the common marine mussel *Mytilus edulis* resulting from exposure to cadmium." Dis. Aquat. Org. **22**: 59-65.

Collie, J. S., G. A. Escanero and P. Valentine (1997). "Effects of bottom fishing on the benthic megafauna of George Bank." Marine Ecology Progress Series **155**: 159-172.

Collie, J. S., S. J. Hall, M. J. Kaiser and I. R. Poiner (2000). "A quantitative analysis of fishing impacts on shelf-sea benthos." Journal of Animal Ecology **69**(5): 785-798.

1. The effects of towed bottom-fishing gear on benthic communities is the subject of heated debate, but the generality of trawl effects with respect to gear and habitat types is poorly understood. To address this deficiency we undertook a meta-analysis of 39 published fishing impact studies.

2. Our analysis shows that inter-tidal dredging and scallop dredging have the greatest initial effects on benthic biota, while trawling has less effect. Fauna in stable gravel, mud and biogenic habitats are more adversely affected than those in less consolidated coarse sediments.

3. Recovery rate appears most rapid in these less physically stable habitats, which are generally inhabited by more opportunistic species. However, defined areas that are fished in excess of three times per year (as occurs in parts of the North Sea and Georges Bank) are likely to be maintained in a permanently altered state.

4. We conclude that intuition about how fishing ought to affect benthic communities is generally supported, but that there are substantial gaps in the available data, which urgently need to be filled. In particular, data on impacts and recovery of epifaunal structure-forming benthic communities are badly needed.

Colomer, J. and H. Fernando (1996). "Resuspension of particle bed by round vertical jet." Journal of Environmental Engineering, **122**(9, 864-869.).

Comel, A. (1969). " Studio comparativo delle caratteristiche chimico-litologiche delle sabbie del litorale veneto tra Trieste e Venezia." Nuovi studi della stazione chimico-agraria sperimentale di Udine pubblicazione **110**: 20-27.

Commito, J. A. (1982). "Importance of predation by infaunal polychaetes in controlling the structure of a soft-bottom community in Maine, USA." Marine Biology, **68**: 77-81.

Commito, J. A. and P. B. Shrader (1985). "Benthic community response to experimental additions of the polychaete *Nereis virens*." Marine Biology **68**: 101-107.

Conan, G. and M. S. Shafee (1978). "Growth and biannual recruitment of the black scallop *Chlamys varia* (L.) in Lanveoc area, Bay of Brest." Journal of Experimental Marine Biology and Ecology **35**(1): 59-71.

Data on growth of the black scallop Chlamys varia were obtained by tagging, raft cage rearing, reading winter growth rings, and analysis of length-frequency distributions. Von Bertalanffy growth curves were fitted to each set of data by least-square regression techniques involving no transformation of variates. The results obtained by the different methods are comparable except for those obtained by length-frequency distribution analysis. Length-frequency distribution analysis seems to be complicated by the presence of a biannual recruitment. Counting growth rings seems to be a more accurate and easier method for growth estimates. The sizes at rings are different for individuals born in spring and for those born in autumn; the growth curves derived for these two types of animals remain different throughout their whole life. The relative proportions of individuals originating from each of the two recruitment groups have remained remarkably homogeneous for the last five years. Comparative study of the allometric relationships between length and width of the shell of the animals from the two recruitment groups showed no significant difference.

Conner, W. G. and J. L. Simpson (1979). "The effects of oyster shell dredging on an estuarine benthic community." Estuarine and Coastal Marine Science **9**: 749-758.

Conover, R. J. (1966). "Assimilation of organic matter by zooplankton." Limnol. Oceanogr. **11**: 338-354.

ConStat (2001). ICC 2000 SELECTIVITY : On-line analysis.. (accessed April 2001).

Costa, C., M. Bianchini, P. Ceccarelli, P. Orecchia, E. Rambaldi and L. Volterra (1987). "Indagine sui molluschi bivalvi di interesse commerciale (telline, cannolichi e vongole) delle coste della Toscana, del Lazio e della Campania, 1985 - 1987." Quad. Ist. Idrobiol. Acquacolt. Brunelli **7**: 3-58.

Cover, P. (1996). "The operation of scallop dredges: An engineering appraisal." MSc. Thesis, Australian Maritime College.

Cover, P. and D. Sterling (1994). "Scallop dredging: an engineering approach." Memoirs of the Queensland Museum **36**(2): 343-349.

Currie, D. R. and G. D. Parry (1996). "Effects of scallop dredging on a soft sediment

community: a large-scale experimental study." Mar. Ecol. Prog. Ser **134**: 131-150.

Da Ros, L., N. Nesto and C. Nasci (2001). AEC e tasso di riaffossamento come possibili biomarkers di stress meccanico da turbosoffiante in *Chamelea gallina* del Nord Adriatico. 32° Congresso SIBM, Numana.

Da Ros, L., N. NESTO and C. NASCI (2002). "AEC and reburrowing rate as possible biomarkers of mechanical stress due to hydraulic dredge fishing on *Chamelea gallina* (Linnaeus, 1758) from North Adriatic Sea." Biol. Mar. Medit. **9**(1): 240-243.

Da Ros, L., N. Nesto, C. Nasci, V. Moschino, D. Pampanin and M. G. Marin (2001). First attemps in evaluating the effects of hydraulic dredging on the target species *Chamelea gallina*: biochemical and behavioural responses. 36th European Marine Biology Symposium, Maò- Menorca.

Da Ros, L., N. Nesto, C. Nasci, V. Moschino, D. Pampanin and M. G. Marin (in prep). "Biochemical and behavioural effects of hydraulic dredging on the target species *Chamelea gallina*." Fisheries Research.

Da Ros, L., D. Pampanin and C. Nasci (2002). Environmental stress effects in clam, *Chamelea gallina*, from Adriatic Sea, Italy. SETAC Europe 12th Annual Meeting, Vienna, Austria.

Daget, J. (1979). Les modeles mathematiques en ecologie. ,. Paris, Masson.

D'Amico, S. and P. Bonaduce (1988). "Valutazione stocks *Venus gallina* nel compartimento di Pescara." Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano per la pesca e l'acquacoltura **1**: 371-402.

Darby, C. D. and J. A. Durance (1989). Use of the North Sea water parcel following model (NORSWAP) to investigate the relationship of larval source to recruitment for scallop (Pecten maximus) stocks of England and Wales. International Council for the Exploration of the Seas (ICES) Shellfish Committee Meeting Paper CM 1989/K:28.

Dare, P. J. (1974). "Damage caused to mussels (*Mytilus edulis* L.) by dredging and mechanised sorting." Journal du Conseil International pour l'Exploration de la Mer **35**: 296-299.

Dare, P. J. and R. C. A. Bannister (1987). Settlement of scallop, *Pecten maximus*, spat on natural substrates off south west England: the hydroid connection. 6th International Pectinid Workshop, Menai Bridge, Wales.

Dare, P. J., C. D. Darby, J. A. Durance and D. W. Palmer (1994). The distribution of scallops (*Pecten maximus*) in the English Channel and Celtic Sea in relation to hydrographic and substrate features affecting larval dispersal and settlement. 9th International Pectinid Workshop, Nanaimo, B.C., Canada.

Dare, P. J., D. Key, C. D. Darby and P. M. Connor (1993). The efficiency of spring-loaded dredges used in the western English Channel fishery for scallops, *Pecten*

maximus (L.), ICES.CM1993/B:15

Three experiments were conduscted to measure the overall efficiency of commercial dredges used to survey scallop stocks. Marked animals were laid on four plots located in the Cornish fishery on inshore and offshore grounds ranging from smooth, sandy or muddy gravels to rougher, stony substrates. Efficiency at catching each 5mm size (shell height) class of scallop was estimated by comparing mean numbers of releases and recaptures per 1000m2 of seabed.

The gear was highly size selective and of low efficiency overall with sunstrate-dependent variations. For these commercial dredges, with spring loaded tooth bars and 75mm belly and bacck meshes, mean efficiency at catching legally fishable (>90mm) scallops ranged from 6% (rough ground) to 41% (smooth muddy gravel). On the most widespread offshore ground type (sand and fine gravels) efficiency on two plots averaged 22%, but it fell rapidly with decreasing scallop size to 1.4% at 65mm and to only 0.2% at 45mm.

Dredge efficiency is the resultant not only of a two-stage selection snd retention process (by toothbar and meshes) but of complex interactions between the gear, the seabed, hydrodynamic forces and the behaviour of the scallops themselves. Overall, spring loaded dredges retain rather few juvenile scallops and, although most effective on moderatly soft grounds, their efficiency generally is low.

Dare, P. J. and D. W. Palmer (1994). The use of dredge efficiency factors for estimating indirectly population composition and abundance of scallops, *Pecten maximus* (L.). 9th Int. Pectinid Workshop, Nanaimo, BC (Canada).

Davids, B. J. and T. P. Yoshino (1998). "Integrin-like RGD-dependent binding mechanism involved in the spreading response of circulating molluscan phagocytes " Dev. Comp. Immunol. **22**: 39-53.

De Alteris, J., L. Skrobe and C. Lipsky (1999). The significance of seabed disturbance by mobile fishnig gear relative to natural processes: a case study in Narraganset Bay, RI. In: Fish habitat: essential fish habitat and rehabilitation. L. B. (ed), American Fisheries Society.**:** pp224 -237.

De Duve, C. (1963). The lysosome concept. Lysosomes, Ciba Foundation Symposium,. A. De Reuck and M. Cameron, Little, Brown and Company, Boston, Massachusetts,**:** 1-35.

de Groot, S. J. (1984). "The impact of bottom trawling on benthic fauna of north sea." Netherlands Institute for Fishery investigatios. Ocean Management **9**: 177-190.

de Groot, S. J. and J. Apeldoorn (1971). Some experiments on the influence of the beam trawl on the bottom fauna.CM 1971/B:2

de Groot, S. J. and H. J. Lindeboom (1994). Environmental impact of bottom gears on benthic fauna in relation to natural resources manangment and proctection of the North Sea.

De Jonge, V. N., Van Der Bergs. (1987). "Experiments on the resuspension of

estuarine sediments containing benthic diatoms." Estuarine Coastal Shelf Sci **24**: 725-740.

De Jonge, V. N., Van Beusekom, J.E.E. (1995). "Wind-and tide-induced resuspension of sediment and microphytobenthos from tidal flats in the Ems estuary." Limnol. Oceanogr **40**(4): 766-778.

De Veen, J. F., P. H. M. Huwae and M. S. S. Lavaleye (1975). "On discarding in the sole fishery and preliminary observations on survival rates discarded plaice and sole in 1975." Comm. Meet int Counc Explor Sea.

De Vooys, C. G. N., A. de Zwaan, J. Roos, E. Carpené and O. Cattani (1991). "Anaerobic metabolism of erythrocytes of the arcid clam *Scapharca inaequivalvis* (Bruguiere): effects of cadmium." Comp. Biochem. Physiol. **98B,**: 169-175.

de Vooys, C. G. N. and J. van der Meer (1998). "Changes between 1931 and 1990 in by-catches of 27 animal species from the southern North Sea." Journal of Sea Research **39**: 291-298.

De Zwaan, A. and R. H. M. Eertman (1996). "Anoxic or aerial survival of bivalves and other euryoxic invertebrates as a useful response to environmental stress. A comprehensive review " Comp. Biochem. Physiol. **113C**: 299-312.

Del Piero, D. (1998). "Indagini sullo stock di *Chamelea gallina* (L. 1758), vongola comune nei compartimenti di Monfalcone (1984-1997) e Venezia (1990-1997)." Biologia Marina Mediterranea **5**(3): 395-399.

Del Piero, D. and D. Fornaroli (1998). "Situazione dello stock di *Chamelea gallina* (L.) nel compartimento marittimo di Venezia (1984/1995)." Biol. Mar. Medit **5**(2): 393-403.

Del Piero, D., D. Fornaroli and M. Balzo (1998). "Situazione dello stock di *Chamelea gallina* (L.) nel Golfo di Trieste dal 1984 al 1995." Biologia Marina Mediterranea **5**(2): 382-392.

Dias, J. (1987). Dinâmica sedimentar e evolução recente da plataforma continental portuguesa setentrional. Lisboa, Portugal., Universidade de Lisboa.

Dickie, L. M. (1955). "Fluctuations in abundance of the giant scallop Placopecten magellanicus (Gmelin), in the Digby area of the Bay of Fundy." Journal of the Fisheries Research Board of Canada **12**: 797-857.

Dickson, G. W. and J. P. Geisy (1982). "Seasonal variation of phosphoadenylates concentrations and adenylate energy charge in the dorsal tail muscle of the crayfish *Procambrus acutus acutus* (Decapoda: Astacidae)." Comp. Biochem. Physiol. **72A**(2): 295-299.

Doerding, P. H. (1982). "Reduction of the sea star predation by the burrowing response of the hard clam *Mercenaria mercenaria* (Mollusca: Bivalvia)." Estuaries, **5**: 310-315.

Donaldson, E. M. (1981). The pituitary-interrenal axis as an indicator of stress in

fish. Stress in fish. A. D. Pickering. London., Academic Press,**:** 11-47.

Downing, J. (1989). "Precision of the mean and the design of benthos sampling programmes: caution revised." **Marine Biology**(103): 231-234.

Downs, C. U. (1988). Intracellular acid phosphatase and lysozyme levels in subpopulations of oysters, *Crassostrea virginica*, hemocytes. J Invertebr Pathol 52, heng, T.C.

Drinkwater, J. (1974). "Scallop dredge selectivity experiments." ICES C.M. 1974/ **K:25**: 5 pp.

Dubois, M., K. A. Gilles, J. K. Hamilton, R. P.A. and F. Smith (1956.). "Colorimetric method for determination of sugars and related substances." Anal. Chem. **28**: 350-356.

Duff, M. (1976). Scallop fishing in Ireland. 1st International Pectinid Workshop, Baltimore, Ireland.

Duggan, N. A. (1987). Recruitment in North Irish Sea scallop stocks, University of Liverpool.

Duncan, P. F. (1993). Post-harvest physiology of the scallop *Pecten maximus* (L.), University of Glasgow**:** 184.

Dupouy, H. (1982). "Comparative study of scallop drags used in France." Can. Transl. Fish. Aquat. Sci., Transl. from French, La Pêche Maritime: 213-218.

Ebberink, R. H. M., W. Zurburg and D. I. Zandee (1979.). "The energy demand of the posterior adductor muscle of *Mytilus edulis* in catch during exposure to a." Marine Biology Letters **ir. 1.**: 23-31.

Economou, A. N. (1991). "Food and feeding ecology of five gadoid larvae in the northern North Sea." J. Cons. int. Explor. Mer **47**: 339-351.

Eertman, R. H. M., A. J. Wagenvoort, H. Hummel and A. C. Smaal (1993). ""Survival in air" of the blue mussels *Mytilus edulis* L. as a sensitive response to pollution-induced environmental stress." J. Exp. Mar. Biol. Ecol. , **170**: 179-195.

Eggleston, D. (1962). Spat of the scallop (Pecten maximus (L.)) from off Port Erin, Isle of Man, Report. Marine Biological Station, Port Erin 74

Eleftheriou, A. and M. R. Robertson (1992). "The effects of experimental scallop dredging on the fauna and physical environment of a shallow sandy community." Neth. J. Sea Res **30**: 289-299.

Elliot, J. M. (1977). Some methods for statistical analysis of samples of benthic invertebrates, Freshwater Biology Association.Scientific Publications 25

Elmhirst, R. (1945). "Clam fishing in the Firth of Clyde." Transactions of the Buteshire Natural History Society **13**: 113-116.

Evans, S. and B. Tallmark (1996). "Growth and biomass of bivalve molluscs on a shallow, sandy bottom in Gullmar Fjord (Sweden)." Zoon **5**(1): 33-38.

Falcão, M. M., M. B. Gaspar, M. Caetano, M. N. Santos and C. Vale (in press). "Ecological impact of clam dredging in coastal waters (south Portugal): chemical disturbance and subsequent recovery of seabed." Marine Environmental Research.

Fanning, K. A., Carter, K.L. Betzer, P.R. (1982). "Sediment re-suspension by coastal waters: A potential mechanism for nutrient re-cycling on the ocean's margins." Deep-sea Res **8A:n**: 953-965.

FAO (1987). "Fiches FAO D´identification des especes pour les besoins de la peche. (Révision 1). Mediterranee et Mer Noire. Zone de peche. Révision 1." Fischer, W.; Schneider, M. & Bauchot, M.-L., (Eds) **Vol I, Vegetaux et Invertebres. Rome, FAO:**: pp 371-512.

Fascari, F. (1998). I fondali delle tre stazioni nel contesto del sistema deposizionale Alto Adriatico: Estratto dal Progetto PRISMA 1 - Rapporto tematica:"Cicli biogeochimici ed indagini ecofisiologiche".4.7

Feder, D. H. (1981). "Aspects of the feeding biology of the brittle star *Ophiura texturata*." Ophelia **20**: 215-235.

Feder, H. M. (1981). The distribution, abundance and diversity of the epifaunal benthic organisms in two (Alitak and Ugak) bays of Kodiak Island, Alaska. Environmental assessment of the Alaskan continental shelf: Volume 2 Fish, plankton, benthos, littoral.

Feng, S. Y. (1965). "Heart rate and leucocyte circulation in *Crassostrea virginica* (Gmelin)." Biol Bull **128**: 198-210.

Ferretti, M., F. Lombardo and G. Romani (1990). Metodi di Pesca dei Molluschi Bivalvi. Vongolare tradizionali e turbo soffianti. Quaderni ICRAP Pesca , 157 pp., Ministero delle Politiche Agricole, 1998a.

Fifas, S. (1991). Analyse et modélisation des paramètres d'exploitation du stock de coquilles Saint-Jacques (*Pecten maximus*, L.) en baie de Saint-Brieuc (Manche Ouest, France). Brest, d'Université, IFREMER/UBO**:** 422 p.

Fifas, S. (1993). Un modèle de capturabilité pour le stock de coquilles Saint-Jacques (*Pecten maximus*, L.) en baie de Saint-Brieuc (Manche, France). Les recherches françaises et évaluation quantitative et modélisation des ressources et des systèmes halieutiques. Halieumétrie. Rennes, Actes du colloque**:** 141-155.

Fifas, S. and P. Berthou (1999). "An efficiency model of a scallop (*Pecten maximus*, L.) experimental dredge: Sensitivity study." ICES Journal of Marine Science **56**: 489-499.

Fifas, S. and B. J. (1997). Analyse de l'impact de la pêche sur la croissance. Exemple de la population de coquilles Saint-Jacques (*Pecten maximus*, L.) de la baie de Saint-Brieuc (Manche Ouest, France). Working Group on Ecosystem Effects of Fishing

Activities.

Fifas, S. and J. Vigneau (in prep). "On some aspects of modelling scallop (*Pecten maximus*, L.) dredge efficiency. Special reference to dredges with depressor plate (English Channel, France)."

Fiorentini, L. and C. Froglia (1988). Valutazione degli stocks di vongole nei compartimenti marittimi di Ancona e S. Benedetto del Tronto: stato di avanzamento e prime considerazioni. Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano per la pesca e l'acquacoltura.

Fish, J. D. and S. Fish (1996). A student's guide to the seashore. Cambridge, Cambridge University Press.

Fitzhugh, J. K. and Fleeger (1985). "A phylogenetic systematic analysis of several hierarchical levels within the order Sabellida (Polychaeta: Annelida)." ABST. INT. PT. B SCI. and ENG. **49**(11): 634.

Fiúza, A. F., Ed. (1983). Upwelling patterns off Portugal. Coastal upwelling: Its sediment record. Part A: Responses of the sedimentary regime to present coastal upwelling. New York, Plenum Press,.

Fleury, P. G., Dao, J.C., Mikolojunas, J.P., Minchin, D., Norman, M., Strand, O., 1997a. (1997). Concerted action on scallop seabed cultivation in Europe (1993 - 1996) AIR 2 - CT 93 - 1647,. Brussels, EU Commission

Fleury, P. G., C. Mingant and A. Castillo (1996). "A preliminary study of the behaviour and vitality of reseeded juvenile great scallops, of three sizes in three seasons." Aquaculture international **4**(4): 325-337.

In order to have a better understanding of recessing in great scallop, Pecten maximus and consequently the causes of mortality at reseeding, this study has monitored, at different seasons, the dispersion and recessing of different sizes of juveniles (about 15, 30 and 45 mm, called 'small', 'medium' and 'large') after seeding. Moreover, the aim was to see when small spat (15 mm) could be seeded, and thus reduce the costs of intermediate culture. Three monitoring approaches were used together: (1) continual observations by remote video camera, of a defined area (less than 1 m(2)) containing 10 scallops from each size group; (2) daily monitoring of behaviour with divers along three bottom lines, with 20 x 1 m(2) plots each and nine marked scallops per plot; and (3) the biochemical content of the muscle: adenylic energetic charge and storage of energy reserves (glucides, proteins, lipids). The video monitoring identified but did not quantify predator behaviour, particularly at night. The role and behaviour of spiny crab, Maia squinado, and of small predators has clearly been shown, such as: (a) small crustaceans, Inachus sp., breaking the edges of scallop valves; and (b) small gobies, Pomatoschistus pictus, pecking the tentacles of the scallop mantle. For the monitoring by divers, filtering appeared much too difficult to look at for it was very disturbed by divers, and anyway the resumption of filtering came immediately after seeding. On the other hand, diver monitoring of dispersal and recessing was quite easy to do with a minimum of practice. On the basis of dispersal, the best seasons for seeding appear to be spring or summer.

In autumn, two-thirds of 'small' and 'medium' juveniles are missing 3 days after seeding, but we could not observe whether they had been eaten by predators or had just moved and recessed farther. There was no experiment in winter owing to adverse conditions for scallop seedings. Biochemical analyses confirmed the unsuitability of autumn for scallop seeding, because of very low glucide content in this season. The adenylic energetic charge in the smooth part of the muscle showed that stress before seeding (aerial exposure, handling), and post-seeding behaviour (swimming, recessing) have a high energetic cost for scallops. In summer and autumn, 3 days after seeding, none of the three size batches recovered their initial vitality.

Fleury, P. G., C. Mingant and A. Castillo (1997). " A preliminary study of the behaviour of reseeded juvenile great scallops of three sizes in three seasons." Aquaculture International **4**: 325-337.

Fonda Umani, S. (1996). "Pelagic production and biomass in the Adriatic Sea." Scientia Marina **60**(2): 65-77.

Fonda Umani, S., P. , P. Franco, E. Ghirardelli and A. Malej (1992). Outline of oceanography and the plankton of the Adriatic Sea. In: Marine Eutrophication and Population Dynamics.

Fonds, M. (1994.). "Mortality of fish and invertebrates in beamtrawl cacthes and the survival changes of discards. *In* Environmental impact of bottom gears on benthic fauna in relation to natural resources management and protection of the North Sea." Ed. By S.J. Groot and H.J. Lindeboom **NIOZ Report 1994-11, RIVO-DLO Report C026/94**.

Forester, A. J. (1979). "The association between the sponge *Halichondria panicea* (Pallas) and scallop *Chlamys varia* (L.): a commensal-protective mutualism." Journal of Experimental Marine Biology and Ecology **36**(1): 1-10.

The scallop Chlamys varia was found associated with an enveloping epizoitic growth of the sponge Halichondria panicea. The bivalve was protected against predatory starfishes by the sponge which interfered with the attachment of tube feet and made the vulnerable byssal opening and valve margins inaccessible to the predator's gastric membranes. Protection was partial or complete depending upon the species of starfish and relative sizes of predator, prey, and epizoite. The effectiveness of the pectinid escape response was enhanced by the sponge which enabled the mollusc to dislodge attacking asteroids. The sponge benefited from an increased supply of suspended nutrients generated by the inhalant current of the host. The partnership is a commensal-protective mutualism of an unspecialized and probably facultative nature. The association has not been reported before although it may have a wide distribution, at least on the Atlantic coast of Ireland.

Forja, J. M., Blasco J., Gómez-Parra. (1994). "Spatial and seasonal variation of *in situ* benthic fluxes in the Bay of Cadiz. (South-west Spain)." Est., Coast. and Shelf Sci **39**: 127-141.

Foucher, E. (1986). L'évolution de la pêcherie de coquilles Saint-Jacques en baie de Saint-Brieuc à partir des licences de pêche. Mémoire ENSAR**:** 71p.

Fowler, S. (1989). "Nature conservation implications of damage to the seabed by

commercial fishing operations." Nature Conservancy Council.

Franchescini, G., F. Pranovi, S. Raicevich, M. G. Farrace. and O. Giovanadi (1999). ""Rapido" trawl fishing in the Northern Adriactic Sea: direct impact on epifauna." *Impact of trawl fishing on benthic communities* - Proceedings:: 49-60.

Franco, P. and A. Michelato (1992). "Northern Adriatic Sea: oceanography of the basin proper and of the western coastal zone." The Science of the Total Environment **Supplement 1992**: 35-62.

Franklin, A. and P. M. Conner (1980). Cardigan Bay scallop survey, September 1980. Ministry of Agriculture Fisheries and Food, Directorate of Fisheries Research, Lowestoft Fisheries Notices. **66**.

Franklin, A. and G. D. Pickett (1980). Shell growth increments in scallops (*Pecten maximus*) from the English Channel. Copenahagen (Denmark), International Council for the Exploration of the Sea.

Franklin, A., G. D. Pickett and P. M. Connor (1980). The scallop (*Pecten maximus*) and its fishery in England and Wales. Ministry of Agriculture, Fisheries and Food, Directorate of Fisheries Research, Lowestoft (U.K.) Laboratory Leaflet. **51**.

Frid, C. L. J., R. A. Clark and J. A. Hall (1999). "Long-term changes in the benthos on a heavily fished ground off the NE coast of England." Marine Ecology Progress Series **188**: 13-20.

Long-term monitoring of 2 benthic stations off the Northumberland coast, NE England, at 80 and 55 m depth, has been carried out since 1971. The 80 m station is located within a Nephrops norvegicus fishing ground, while the 55 m station is located outside of the main fished area. In this study we compare the fauna of the heavily fished site with that of the shallower site over a period during which fishing effort changed. Changes in macrofaunal abundance at the station outside the fishing ground reflected changes in organic input. This was also the case at the fished station except during the period of highest fishing activity when this relationship broke down. This suggests that the dynamics of the macrobenthos at this station were influenced by fishing activity. Individual taxa were categorised a priori, based on literature accounts of their response to fishing. At the site outside the fishing ground the proportion of individuals predicted a priori to increase and that predicted to decrease in response to the direct effects of fishing did not vary. At the heavily fished station the increase in fishing effort in the early 1980s did not alter the abundance of the taxa predicted to decline, but the abundance of individuals in taxonomic groups predicted to increase did change in the predicted direction. The differences in the dynamics of the 2 stations, which differed in their fishing intensity, provide some evidence for a role of direct effects of fishing in determining the abundance and composition of coastal macrofauna.

Froelich, P. N., Bender, M.L., Luedtke, N.A., Heath, G.R., DeVries, T (1982). "The marine phosphorus cycle." Am. J. Sci **282**: 474-511.

Froelich, P. N. (1988). "Kinetic control of dissolved phosphate in natural rivers and estuaries: a primer on the phosphate buffer mechanism." Limnol. Oceanogr **33**: 649-

668.

Froglia, C. (1975). "Aspetti biologici, tecnologici e statistici della pesca alle vongole (Venus gallina)." Quad. Lab. Tecnol. Pesca **9**: 7-22.

Froglia, C. (1975). "Osservazioni sull'accrescimento di *Chamelea gallina* (L.) ed *Ensis minor* (Chenu) nel Medio Adriatico." Quad. Lab. Tecnol. Pesca **2**(1): 37-48.

Froglia, C. (1989). Clam fisheries with hydraulic dredges in the Adriatic Sea. In: Marine Invertebrate Fisheries: their Assessment and Management., Ed. J.F. Caddy, Wiley Interscience Publication.

Froglia, C. (1989.). Clam fishery with hydraulic dredge in the Adriatic Sea. Marine Invertebrate Fisheries: Their Assessment and Management, . New York, Wiley Interscience Publications.

Froglia, C., E. Antolini, E. Arneri, M. E. Gramitto, M. La Mesa and R. Polenta (1998). "Valutazione della consistenza dei banchi di vongole nei compartimenti marittimi di Ancona e S. Benedetto del Tronto nel periodo 1984-1997." Biologia Marina Mediterranea **5**(3): 375-384.

Froglia, C., R. Polenta, E. Arneri and B. Antolini (1998). "Osservazioni sulle fluttuazioni del reclutamento di Anadara inaequivalvis (Bruguiere, 1789) e *Chamelea gallina* (L., 1758) nel Medio Adriatico." Biologia Marina Mediterranea **5**(1): 290-298.

Fryer, R. J. (1991). "A model of between-haul variation in selectivity." - ICES Journal of Marine Science **48**: 281-290.

Gäde, G. and G. Meinardus (1981). "Anaerobic metabolism of the common cockle *Cardium edule*." Mar. Biol., **65**: 113-116.

Gäde, G., E. Weeda and P. A. Gabbott (1978). " Changes in the level of octopine during the escape responses of the scallop, *Pecten maximus* (L.)." J. Comp. Physiol. **124**: 121-127.

Gamito, S. (1994). The benthic ecology of some Ria Formosa lagoons, with reference to the potential for production of the gilhead seabream (*Sparus aurata*, L.). Faro, Portugal, Universidade do Algarve.

Gaspar, M. B. (1996). Bivalves do litoral oceânico algarvio. Aspectos da biologia, ecologia e da pescaria dos mananciais de interesse económico: aplicação à gestão dos recursos., University of Algarve, Faro,**:** 280 pp.

Gaspar, M. B. (1996). Bivalves do litoral oceânico algarvio. Aspectos da biologia, ecologia e da pescaria dos mananciais de interesse económico: aplicação à gestão dos recursos (Bivalves of the Algarve coast. Biology aspects, ecology and fisheries of the commercial stocks: application to the resource management). Univ. Algarve,**:** 317 p.

Gaspar, M. B., R. C. A. and C. C. Monteiro (1994). "Annual shell banding, age, and

effects of dredging on the shells of a population of the razor clam *Ensis siliqua* L., from Barrinha, south of Portugal." Jour. Mar. Biol. Ass. UK **74**: 927-938.

Gaspar, M. B., M. Castro and C. C. Monteiro (1995). "Age and growth rate of the clam *Spisula solida* L., from a site off Vilamoura, south Portugal, determined from acetate replicas of shell sections." Scientia Marina **59**(1): 87-93.

Gaspar, M. B., M. Castro and C. C. Monteiro (1998). "Influence of tow duration and tooth length on the number of damaged razor clams *Ensis siliqua*." Marine Ecology Progress Series **169**: 303-305.

Gaspar, M. B., M. Castro and C. C. Monteiro (1999). "Effect of tooth spacing and mesh size on the catch of the Portuguese clam and razor clam dredge." ICES Journal of Marine Science **56**: 103-110.

Gaspar, M. B., M. D. Dias, A. Campos, C. C. Monteiro, M. N. Santos, A. Chicharo and L. Chicharo (In press). "The influence of dredge design on the catch of *Callista chione*." Hydrobiologia.

Gaspar, M. B., M. D. Dias, A. Campos, C. C. Monteiro, M. N. Santos, A. Chícharo and L. Chícharo (2001). "The influence of dredge design on the catch of *Callista chione* (L. 1758)." Hydrobiologia **465**: 153-167.

Gaspar, M. B., M. D. Dias and C. C. Monteiro (1998). "A pescaria de bivalves do litoral oceânico da região de Setúbal: situação actual dos principais bancos (Junho de 1997)." Rel. Tec. Cient. IPIMAR, Lisboa:: 12p.

Gaspar, M. B., F. Leitão, M. N. Santos, L. Chícharo, D. Damásia, A. Chícharo and C. C. Monteiro (in press). "A comparison of direct macrofaunal mortality using three types of Portuguese clam dredge." ICES Journal of Marine Science.

Gaspar, M. B., F. Leitão, M. N. Santos, L. Chícharo, D. Damásia and C. C. Monteiro (in press). "A comparison of direct macrofaunal mortality using three types of Portuguese clam dredge." ICES Journal of Marine Science.

Gaspar, M. B., F. Leitão, M. N. Santos, M. Sobral, L. Chícharo, A. Chícharo and C. C. Monteiro (2002). "Influence of mesh size and tooth spacing on the number of damaged organisms in the Portuguese clam dredge fishery." ICES Journal of Marine Science **59** (6): 1228-1236.

Gaspar, M. B., F. Leitão, M. N. Santos, M. Sobral, L. Chícharo, A. Chícharo and C. C. Monteiro (2003). "Size selectivity of the *Spisula solida* dredge in relation to tooth spacing and mesh size." Fisheries Research **60**(2-3): 561-568.

Gaspar, M. B. and C. C. Monteiro (1998). "Reproductive cycles of the razor clam *Ensis siliqua* and the clam *Venus striatula* off Faro, southern Portugal." Jour. Mar. Biol. Ass. UK **78**: 1247-1258.

Gaspar, M. B. and C. C. Monteiro (1999). "Indirect mortality caused to juveniles of *Spisula solida* due to deck exposure." J. Mar. Biol. Ass. UK **79**(3): 566-568.

Gaspar, M. B., M. N. Santos, F. Leitão, L. Chícharo, A. Chícharo and C. C. Monteiro (in press). "Recovery of substrates and macro-benthos after fishing trials with a new Portuguese clam dredge." Journal Marine Biological Association U.K.

Gatto, P. (1984). Il cordone litoraneo della laguna di Venezia e le cause del suo degrado. In: Progetto Finalizzato Promozione della Qualità dell'Ambiente, sottoprogetto Acqua (Un.Op. 2,1,7/a3):

Gaudette, H. E., R. F. Wilson, L. Toner and D. V. Folger (1974). "An inexpensive titration method for the determination of organic carbon in recent sediments." J. Sediment. Petrol. **44**: 249-253.

Gehan, E. A. (1965). A generalised Wilcoxon test for comparing arbitrarily single-censored samples Biometrica, 52

Gibbs, R. J., Matthews, M.D. and Link, D.A. (1971). "The relationship between sphere size and settling velocity." Journal of Sedimentary Petrology **41**(1): 7-18.

Gibbs, R. J., M. M.D. and D. A. D. Link "The relationship between sphere size and settling velocity." Journal of Sedimentary Petrology, **41**(1): 7-18.

Gilkinson, K., M. Paulin, S. Hurley and P. Schwinghamer (1999). "Impacts of trawl door scouring on infaunal bivalves: results of a physical trawl door model/dense sand interaction." J. Exp. Mar. Biol. Ecol. **224**(2): 291-312.

Gilkinson, K. D., D. C. Schwinghamer, D. C. J. Gordon, J. Prena, T. W. Rowell, D. L. McKeown, W. P. Vass, K. McIsaac, C. Bourbonnais, M. Paulin and S.-. Hurley (1999). Impacts of otter-trawling on infaunal bivalves living in sandy bottom habitats on the Grand Banks of Newfoundland. Abstract book, ICES/SCOR Symposium - Ecosystem effects of fishing., Montpellier, France.

Giovanardi, O., F. Pranovi and G. Franceschini (1998). ""Rapido" trawl fishing in the Northern Adriatic: preliminary observations of the effects on macrobenthic communities." Acta Adriatica **39**(1): 37-52.

Gisbert, E., L. Cardona and F. Castello-Orvay (1995). "Alimentacion de los alevines de mugilidos en el delta del Ebro." MISC. ZOOL. **18**: 145-151.

Goldberg, E. D., V. T. Bowen, J. W. Farrington, G. Harvey, J. H. Martin, P. L. Parker, R. W. Risebrough, W. Robertson, E. Schneider and E. Gamble (1978). The mussel watch Environ. Conserv., .

Goldfisher, S. (1965). "The cytochemical demonstration of lysosomal aryl sulphatase activity by light and electron microscopy " J Histochem Cytoc **13** 520-523.

Gomori, G. (1948). "Histochemical demonstration of sites of choline esterase activity " Proceedings of the Society for Experimental Biology and Medicine **68** 354-358.

Graham, R. C. and M. J. Karnovsky (1966). "The early stage of adsorption of injected horseradish peroxidase in the proximal tubules of mouse kidney: ultrastructural

cytochemistry by a new technique " J Histochem Cytoc **14** 291-302.

Grall, J., C. L., T. G., F. S., G. M. and P. Y.M. (1996). "Distribution of *Pecten maximus* (L.) and its main potentiel competitors and predators in the Bay of Brest." Acad. Sci. ser. 3 Sci vie/Life Sci. **319**(10): 931-937.

Grasshoff, K. (1976). "Methods of seawater analysis." *-Verlag chemie-New York*:: 317p.

Greenstreet, S. P. R. and S. J. Hall (1996). "Fishing and the ground-fish assemblage structure in the north-western North Sea: an analysis of long-term and spatial trends." Journal of Animal Ecology **65**: 577-598.

Grémare, A. and G. Vétion (1994). "Comparison of several spectrofluorometric methods for measuring RNA and DNA concentrations in the deposit-feeding bivalve *Abra ovata*." Comp. Biochem. Physiol. **107B(2)**: 297-308.

Groen, P. (1967). "On the residual transport of suspended matter by an alternating tidal current." Neth. J. Sea Res. **3**: 564-574.

Grosvik, B. E. and A. Goksoyr (1996). "Biomarker protein expression in primary culture of salmon (*Salmo salar* L) hepatocytes exposed to environmental pollutants." Biomarkers **1,**: 45-53.

Gruffydd, L. D. (1972). "Mortality of scallops on a Manx scallop bed due to fishing." J Mar Biol Ass U K **52**: 449-445.

Gruffydd, L. D. (1974). "The influence of certain environmental factors on the maximum length of the scallop, Pecten maximus L." Journal du Conseil International pour l'Exploration de la Mer **35**: 300-302.

Gruffydd, L. D. (1974). "An estimate of natural mortality in an unfished population of the scallop Pecten maximus (L.)." Journal du Conseil International pour l'Exploration de la Mer **35**: 209-210.

Guyader, O. and S. Fifas (1999). Evaluation des bénéfices et des coûts de la transition vers une pêche responsable. La pêcherie de coquille Saint-Jacques (*Pecten maximus*, L.) de la Baie de Saint-Brieuc (France). Rapport à la Direction des Pêches Maritimes et des Cultures Marines dans le cadre du Comité des pêcheries de l'OCDE

Hagen, N. T. (1994.). Is righting response a useful indicator of functional well-being in the green sea urchin *Strongylocentrotus droebachiensis*? Echinoderms through time. G. David, Feral, Roux. Rotterdam, Balkema**:** 693-698.

Hall, S. J. (1994). "Physical disturbance and marine benthic communities: life in unconsolidated sediments." *Oceanography and Marine Biology: an Annuals Review*, **32**: 179-239.

Hall, S. J., D. J. Basford and M. R. Robertson (1990). "The impact of hydraulic dredging for razor clams *Ensis* sp. on an infaunal community." Netherland Journal of Sea

research **27**(1): 119-125.

Hall, S. J., M. R. Robertson, D. J. Basford and S. D. Heaney (1993). "The possible effects of fishing disturbance in the northern North Sea: An analysis of spatial patterns in community structure around a wreck." Netherlands Journal of Sea Research **31**: 201-208.

Hallermeier, R. (1981). "Terminal settling velocity of commonly occurring sand grains." Sedimentology, **28,**: 859-865.

Hall-Spencer, J. (1995). "The effects of scallop dredging on maerl beds in the Firth of Clyde." Porcupine Newsletter **6**: 18-21.

Hall-Spencer, J. (1998). "Conservation issues relating to maerl beds as habitats for molluscs." Journal of Conchology: 271-285.

Maerl beds are little studied shallow marine habitats that have a patchy distribution around the British Isles. They ale mixed sediment deposits built by a surface layer of slow growing coralline seaweeds that are of international conservation significance. Baseline information is provided on the high diversity and abundance of mollusc assemblages associated with Scottish maerl deposits. Commercial extraction and the use of towed demersal fishing gears kills the plants upon which survival of this habitat depends. The molluscan fauna of a site impacted by scallop dredging is compared with that of an unimpacted site. The need to conserve maerl habitats is highlighted as there is concern over the extent to which maerl beds are being disturbed in Europe and how activities such as scallop dredging affect the ecology of these fragile nearshore habitats.

Hall-Spencer, J. M., F. C, R. J. A. Atkinson and P. G. Moore (1999). "The impact of Rapido trawling for scallops, *Pecten jacobaeus* (L.), on the benthos of the Gulf of Venice." ICES Journal of Marine Science, **56**: 111-124.

Hall-Spencer, J. M., C. Froglia, R. J. A. Atkinson and P. J. Moore (1999). "The impact of Rapido trawling for scallops, *Pecten jacobaeus* (L), on the benthos of the Gulf of Venice." ICES J. Mar. Sci **56**: 111-124.

Hall-Spencer, J. M. and P. G. Moore (2000). Impact of scallop dredging on maerl grounds. The Effects of Fishing on Non-target Species and Habitats: Biological, Conservation, and Socio-Economic Issues. M. J. Kaiser and S. J. d. Groot. Oxford, Blackwell Science**:** 105-117.

Hall-Spencer, J. M. and P. G. Moore (2000). "Scallop dredging has profound, long-term impacts on maerl habitats." ICES Journal of Marine Science **57**(5): 1407-1415.

Maerl beds are mixed sediments built by a surface layer of slow-growing, unattached coralline algae that are of international conservation significance because they create areas of high biodiversity. They are patchily distributed throughout Europe (to similar to 30 m depth around the British Isles and to similar to 120 m depth in the Mediterranean) and many are affected by towed demersal fishing. We report the effects of Newhaven scallop dredges on a previously unfished maerl bed compared with the effects on similar grounds that have been fished commercially in the Clyde Sea area; Scotland. Sediment cores were taken to assess the population density of live maerl thalli prior to scallop

dredging on marked test and control plots. These plots were then monitored biannually over a four-year period. Live maerl thalli were sparsely distributed at the impacted site, and experimental dredging had no discernible effect on their numbers. The previously unfished ground had dense populations of live maerl and scallops (both Aequipecten opercularis and Pecten maximus). While counts of live maerl remained high on the control plot, scallop dredging led to a >70% reduction with no sign of recovery over the subsequent four years. The vulnerability of maerl and associated benthos (e.g., the delicate bivalve, Limaria hians) is discussed in relation to towed demersal fishing practices. (C) 2000 International Council for thc Exploration of tho Sea.

Hancock, D. A. (1973). "The relationship between stock and recruitment in exploited invertebrates." Rapport et Procès-Verbaux des Réunions. Conseil International pour l'Exploration de la mer **164**: 113-131.

Hansen, H. P. and F. E. Koroleff (1999). Determination of nutrients. Methods of Seawater Analysis. K. C. a. M. E. K. Grasshoff, Wiley-VCH Verlag:. **159-228**.

Hardy, S. W., T. C. Fletcher and J. A. Olafsen (1977). Aspects of cellular and humoral defence mechanisms in the pacific oyster, *Crassostrea gigas*. Developmental Immunobiology. J. Solomon and J. Horton, Amsterdam Elsevier North Holland Biomedical Press,**:** 59-66.

Hawkins, L. E., J. D. Brooks, S. Brooks and S. Hutchinson (1993). "The effect of tidal exposure on aspects of metabolic and immunological activity in the hard clam *Mercenaria mercenaria* (Linnaeus)." Comp. Biochem. Physiol. **140A,**: 225-228.

Hawkins, S. J., R. D. M. Nash and A. R. Brand (1991). The effects of disturbance in benthic communities: studies in an area closed to scallop dredging., University of Liverpool

Hayashi, M. (1971). "Demonstration of acid phosphatase activity using 1-acetyl-3-indolyl phosphate as substrate " J Histochem Cytochem **19** 175-185.

Hayashi, M., Y. Nakajima and W. H. Fishman (1964). "The cytologic demonstration of ß-glucuronidase employing naphtol AS-BI glucuronide and hexazonium pararosanilin; a preliminary report " J Histochem Cytochem **12** 293-297.

Hedges, J. I. and J. H. Stern (1984). "Carbon and Nitirogen determination of carbonate-containing solids." Limnol. and Oceanogr **19**: 984-989.

Heipel, D. A., Bishop, J. D. D., Brand, A. R. & Thorpe, J. P (in press). Population genetic structure of the great scallop *Pecten maximus* (L.) in the northern Irish Sea revealed by randomly amplified polymorphic DNA. Molecular Ecology.

Heipel, D. A., J. D. D. Bishop and A. R. Brand (1999). "Mitochondrial DNA variation among open-sea and enclosed populations of the scallop *Pecten maximus* in western Britain." Journal of the Marine Biological Association of the United Kingdom **79**(4): 687-695.

The great scallop Pecten maximus (Bivalvia: Pectinidae) supports a substantial European fishery with a recent history of declining catches caused by over-

exploitation. The sustainable exploitation of shellfish populations requires knowledge of the extent to which commercial grounds are reproductively self-sustaining or supplied with larvae originating from further afield. The degree of genetic differentiation between locations can provide important indirect evidence, reflecting the pattern and scale of effective larval dispersal. Pecten maximus were sampled from five locations around the Isle of Man, from Mulroy Bay (Ireland) and from Plymouth. Restriction-site variation was investigated in two PCR-amplified mitochondrial DNA fragments of 2 and 3 kb, respectively Haplotype and nucleotide diversity within populations, and nucleotide divergence between populations, were calculated. Mean nucleotide sequence divergence was corrected for within-population polymorphisms and visualized by UPGMA cluster diagrams. Molecular analysis of variance (AMOVA) was carried out. Results showed low levels of population differentiation. Slight but significant differentiation between Isle of Man populations was revealed, with East Douglas appearing distinct from the remaining Manx locations. The analyses also indicated the distinction of Mulroy Bay from the other populations, and the lowest genetic variability was recorded from this enclosed habitat. This probably reflects the relative isolation of Mulroy Bay, whereas dynamic hydrographic conditions in the Irish Sea and the Channel may generally ensure extensive mixing of the planktonic larvae.

Heipel, D. A., J. D. D. Bishop, A. R. Brand and J. P. Thorpe (1998). "Population genetic differentiation of the great scallop *Pecten maximus* in western Britain investigated by randomly amplified polymorphic DNA." Marine Ecology Progress Series **162**: 163-171.

Randomly amplified polymorphic DNA (RAPD) banding patterns were compared between samples of the same year class of the scallop Pecten maximus (L.) from 5 locations (beds) within the commercial fishing grounds around the Isle of Man (UK). Phenotypic analysis of molecular variance (AMOVA) indicated that significant differentiation was present between these beds, although this accounted for only 2% of total variation, the remainder being between individuals within beds. As confirmed by multivariate analyses (PCOORD and UPGMA clustering), samples from the 2 northern Isle of Man beds resembled each other particularly closely, as did 2 southwestern beds, while the fifth, East Douglas, was relatively distinct. Comparison was extended to 2 samples taken outside the Irish Sea, from Mulroy Bay (Co. Donegal, Eire) and Plymouth (southwest England). Differentiation between the 3 regions was significant, accounting for 7% of total variation in a data set with balanced regional representation. A Mantel test on the whole data set revealed no significant correlation of phenotypic distance, based on RAPD banding pattern, with geographic distance. The potential correlation was largely destroyed by the marked differentiation of the population in Mulroy Bay, a semi-enclosed sea lough, and by the unexpectedly high phenotypic similarity between the Plymouth sample and the 2 northernmost Isle of Man samples. The RAPD data presented here provide the first evidence of population genetic structuring in exploited open-water stocks of this species, since previous allozyme studies of P. maximus have indicated genetic uniformity. Differentiation of the Mulroy Bay population from open-water stocks has been demonstrated previously in a study of mtDNA polymorphisms.

Henderson, S. M. and C. A. Richardson (1994). "A comparison of the age, growth rate and burrowing behaviour of the razor clams, *Ensis siliqua* and *E. ensis*." J. mar. biol.

Ass. U.K **74**: 939-954.

Henriksen, K. R., M.B. Jensen, A. (1983). "Effect of bioturbation on microbial nitrogen transformations in the sediment and fluxes of ammonium and nitrate to the overlying water." Ecol. Bull **35**: 193-205.

Hentschel, B. T. (1998). "Spectrofluorometric quantification of neutral and polar lipids suggested a food-related recruitment bottleneck for juveniles of a deposit-feeding polychaete population." Limno. and Oceano **43(3)** 543-549.

Hergas, C. (1999). "Croissance de populations de *Pecten maximus* en Bretagne : essai de qualification de l'effet de la pêche." Mémoire DEA Océan. Biol., Paris **VI**: 33p + figures, bibliographie, annexes.

Hill, A. S., A. R. Brand, L. O. Veale and S. J. Hawkins (1997). Assessment of the effects of scallop dredging on benthic communities. Liverpool, University of Liverpool.Contract CSA 2332

Hill, A. S., A. R. Brand, U. A. W. Wilson, L. O. Veale and S. J. Hawkins (1996). Estimation of by-catch composition and the numbers of by-catch animals killed annually on Manx scallop fishing grounds. Aquatic predators and their prey. S. P. R. Greenstreet and M. L. Tasker. Oxford, Blackwell Scientific**:** 111-115.

Hill, A. S., L. O. Veale, D. Pennington, S. G. Whyte, A. R. Brand and R. G. Hartnoll (1999). "Changes in Irish Sea benthos: possible effects of forty years of dredging." Estuarine and Coastal Shelf Science **10.**: 739-750.

From 1946 to 1951 Dr N. S. Jones sampled the benthos around the south of the Isle of Man from over 200 sites. Multivariate methods have been used here to compare subsets of this historical data with recent data from the same locations: of these locations some have been subject to heavy scallop dredging over the intervening 40 plus years and some to little dredging. Clear changes were apparent regardless of scallop dredging intensity. Some of the changes in the heavily dredged areas were those expected to result from extreme physical disturbance-an increased polychaete mollusc ratio, loss of some fragile species, and an increase in the predominance of scavenger/predator species. However, changes in the lightly dredged areas also included the loss of a number of species including some potentially fragile tube-dwellers. Reasons for these changes were not apparent. (C) 1999 Academic Press.

Himmelman, J. H. (1988). "Movement of whelks (*Buccinum uindatum*) towards a baited trap." Mar. Biol **97**: 521-531.

Hine, P. M. (1999). "The inter-relationships of bivalve haemocytes " Fish Shellfish Immunol **9** 367-385.

Holden, J. A., R. K. Pipe, A. Quaglia and G. Ciani (1994). "Blood cells of the arcid clam *Scarpharca inaequivalvis*." J Mar Biol Ass UK **74**: 287-299.

Holme, N. A. and A. D. McIntyre (1984). Methods for the study of marine benthos.

Holm-Hansen, O., C. J. Lorenzen, R. W. Holmes and J. D. H. Strickland (1965).

"Fluorometric determination of chlorophyll." J. Cons. perm. Int. Explor. Mer. **30**: 3-15.

Hose, J. E., G. G. Martin, V. A. Nguyen, J. Lucas and R. A.T (1987). "Cytochemical features of shrimp hemocytes " Biol Bull **173** 178-187.

Houghton, R. G., T. Williams and R. W. Blacker (1971). Some effects of double beam trawling, ICES.C.M-ICES 1975/B: 5

Huffman, J. E. and M. R. Tripp (1982). "Cell types and hydrolytic enzymes of soft shell clam (*Mya arenaria*) hemocytes." J Invertebr Pathol **40**: 68-74.

Hynes, R. O. (1999). Cell adhesion: old and new questions TIBS 24, M33-37.

ICES (1975). Resolution 1975/4:22

Ingall, E. D., Jahnke, R.A. (1994). "Evidence for enhanced phosphorus regeneration from marine sediments overlain by oxygen depleted waters." Geochim. Cosmochim **Acta, 58**: 2571-2575.

Isani, G., O. Cattani, M. Zurzolo, C. Pagnucco and P. Cortesi (1995). "Energy metabolism of the mussel, *Mytilus galloprovincialis*, during long-term anoxia." Compend. Biochem. and Physiol. **110B**(1): 103-113.

Isani, G., R. Serra, O. Cattani, P. Cortesi and E. Carpene (1997). "Adenylate Energy Charge and methallothionein as a stress indices in *Mytilus galloprovincialis* exposed to cadmium and anoxia." J. Mar. Biol. Ass. U.K. **77**: 1187-1197.

Ivanovici, A. M. (1980). "The Adenylate Energy Charge in the estuarine mollusc, *Pyrazus ebeninus*. Laboratory studies of responses to salinity and temperature." Comp. Biochem. Physiol., **66(A)**: 43-55.

Jamieson, G. S., Campbell, A. (1985). "Sea scallop fishing impact on American lobsters in the Gulf of St Lawrence." Fish. Bull **83**.

Jamieson, G. S. a. A. C. (1985). "Sea scallop fishing impact on American lobsters in the Gulf of St. Lawrence." Fisheries Bulletin **83**(575-586).

Jenkins, S., B. Beukers-Stewart and A. Brand (2001). "Impact of scallop dredging on benthic megafauna: a comparison of damage levels in captured and non-captured organisms." Marine Ecology Progress Series **215**: 297-301.

Jenkins, S. R. and A. R. Brand (2001). "The effect of dredge capture on the escape response
of the great scallop, *Pecten maximus* (L.): implications for the survival of undersized discards." J. Exp. Mar. Biol. Ecol. **266**: 33-50.

Jenkins, S. R., W. Lart, B. J. Vause and A. R. Brand (2003). "Seasonal swimming behaviour in the queen scallop (*Aequipecten opercularis*) and its effect on dredge fisheries." J. Exp. Mar. Biol. Ecol. **289**: 163-179.

Jenner, K., K. W. Strong and P. Pocklington (1991). A review of fishery related seabed

disturbance in the Scotia-Fundy region, Industry Services and Native Fisheries Branch.Project Report No. 166

Jennings, S. and M. J. Kaiser (1998). "The effect of fishing on marine ecosystems." *Advances in Marine Biology* **34**: 201-252.

Jennings, S., J. K. Pinnegar, N. V. C. Polunin and K. J. Warr (2001). "Impacts of trawling disturbance on the trophic structure of benthic invertebrate communities." Marine Ecology Progress Series **213**: 127-142.

Bottom trawling causes chronic and widespread disturbance to the seabed in shallow shelf seas and could lead to changes in the trophic structure and function of benthic communities, with important implications for the processing of primary production and the wider functioning of the marine ecosystem. We studied the effects of bottom trawling on the trophic structure of infaunal and epifaunal benthic communities in 2 regions (Silver Pit and Hills) of the central North Sea. Within each region, we quantified long-term (over 5 yr) differences in trawling disturbance at a series of sites (using sightings data from fishery protection flights), and related this to differences in the biomass and trophic structure of the benthic community. There were 27- and 10-fold differences in levels of beam trawl disturbance among the Silver Pit and Hills sites respectively, and we estimated that the frequency with which the entire area of the sites was trawled ranged from 0.2 to 6.5 times yr(-1) in the Silver Pit and 0.2 to 2.3 times yr(-1) in the Hills. The impacts of fishing were most pronounced in the Silver Pit region, where the range of trawling disturbance was greater. Infaunal and epifaunal biomass decreased significantly with trawling disturbance. Within the infauna, there were highly significant decreases in the biomass of bivalves and spatangoids (burrowing sea-urchins) but no significant change in polychaetes. Relationships between trophic level (estimated using nitrogen stable isotope composition, delta N-15) and body mass (as log(2) size classes) were rarely significant, implying that the larger individuals in this community did not consistently prey on the smaller ones. For epifauna, the relationships were significant, but the slopes or intercepts of the fitted linear regressions were not significantly related to trawling disturbance. Moreover, mean delta N-15 Of the sampled infaunal and epifaunal communities were remarkably consistent across sites and not significantly related to trawling disturbance. Our results suggest that chronic trawling disturbance led to dramatic reductions in the biomass of infauna and epifauna, but these reductions were not reflected in changes to the mean trophic level of the community, or the relationships between the trophic levels of different sizes of epifauna. The trophic structure of intensively trawled benthic invertebrate communities may be a robust feature of this marine ecosystem, thus ensuring the efficient processing of production within those animals that have sufficiently high intrinsic rates of population increase to withstand the levels of mortality imposed by trawling.

Jones, J. B. (1992). "Environmental impact of trawling on the seabed: a review." New Zealand Journal of Marine and Freshwater Research **26**(1): 59-67.

Jones, N. S. (1950). "Marine bottom communities." Biological Review **25**: 283-313.

Jones, N. S. (1951). "The bottom fauna off the south of the Isle of Man." Journal of Animal Ecology **20**: 132-144.

Jones, N. S. (1956). "The fauna and biomass of a muddy sand deposit off Port Erin, Isle of Man." Journal of Animal Ecology **25**: 217-252.

Justic, D. (1987). "Long-term eutrophication of the Northen Adriatic Sea " Mar. Poll. Bull. **18**(6): 284-287.

Kaiser, M. J. and S. J. de Groot (2000). The Effects of Fishing on Non-target Species and Habitats: Biological, Conservation and Socio-Economic Issues. Oxford, Blackwell Science.

Effects of scallop dredging on gravelly seabed communities.

Kaiser, M. J., D. B. Edwards, P. J. Armstrong, K. Radford, N. E. L. Lough, R. P. Flat and H. D. Jones (1998). "Changes in megafauna benthic communities in different habitats after trawling disturbance." ICES Journal of Marine Science **55**: 353-361.

Kaiser, M. J., A. S. Hill, K. Ramsay, B. E. Spencer, A. R. Brand, L. O. Veale, K. Prudden, E. I. S. Rees, B. W. Munday, B. Ball and S. J. Hawkins (1996). "Benthic disturbance by fishing gear in the Irish Sea: a comparison of beam trawling and scallop dredging." Aquatic conservation: marine and freshwater ecosystems **6**: 269-285.

Kaiser, M. J. and K. Ramsay (1997). "Opportunistic feeding by dabs within areas of trawl disturbance: possible implications for increased survival." Marine Ecology Progress Series **152**: 307-310.

Kaiser, M. J., K. Ramsay, C. A. Richardson, F. E. Spence and A. R. Brand (2000). "Chronic fishing disturbance has changed shelf sea benthic community structure." J. Anim. Ecol. **69**: 494-503.

Kaiser, M. J. and B. E. Spencer (1994). "Fish scavenging behaviour in recently trawled areas." Marine Ecology Progress Series **112**: 41-49.

Fish move in rapidly. Feed on damaged animals AND scavenging invert species.

Kaiser, M. J. and B. E. Spencer (1995). "Survival of by-catch from a beam trawl." Marine Ecology Progress Series **126**: 31-38.

The passage of a beam trawl across the seabed leads to the direct mortality, or indirect mortality through subsequent predation, of some benthic species. In addition, animals retained in, or those that pass through, the cod end may also die as a result of the fishing process. The extent of this additional mortality needs to be quantified to calculate total mortality of non-target species associated with this type of fishery. Hence, we investigated the survival of animals caught by a 4 m beam trawl, in order to identify those species most sensitive to capture. Starfishes, hermit crabs and molluscs were highly resistent to the effects of capture (>60% survived in all cases). Fishes (except dogfish), sea urchins and swimming crabs suffered higher mortality after capture. Generally, the majority of the animals that passed through the meshes of the cod end survived. Experimental investigation of the cause of damage to certain species concluded that the chain matrix fitted to the gear

was largely responsible for the injuries sustained. The types of injuries and their extent were species-specific, and were related to the fragility and physical characteristics of each species. Our experiments revealed that while some species are highly sensitive to capture, others are capable of surviving the effects of capture.

Kaiser, M. J. and B. E. Spencer (1996). "The effects of beam-trawl disturbance on infaunal communities in different habitats." J. Anim. Ecol **65**: 348-358.

Kaiser, M. J. and B. E. Spencer (1996). Behavioural responses of scavengers to beam trawl disturbance. Aquatic predators and their prey. S. P. R. Greenstreet and M. L. Tasker. Oxford, Blackwell Scientific**:** 116-123.

Kaplan, E. L. and P. Meier (1958). "Nonparametric estimation from incomplete observations " J. Am. Stat. Assoc **53** 457-481.

Kaufmann, M. J., M. N. L. Seaman, C. Andrade and F. Buchholz (1994). "Survival, growth, and glycogen content of pacific oysters, *Crassostrea gigas* (Thunberg 1793), at Madeira-Island (subtropical Atlantic)." J. Shell. Res. **13**(2): 503-505.

Kauwling, T. J. and G. J. Bakus (1979). "Effects of hydraulic clam harvesting in the Bering Sea." Tetra Tech. Report TC3324: 183pp.

Kennedy, A. D. (1994). " Predation within meiofaunal communities: description and results of a rapid-freezing method of investigation." Marine Ecology Progress Series, **114**: 71-79.

Kleerekopper, H., H. Gruber and D. Matis (1975). "Accuracy of localization of a chemical stimulus in flowing and stagnant water by nurse sharck, *Ginglymostoma cirratum*." J. comp. Physiol **98**: 257-275.

Knox, G. A. (1986). Estuarine ecosystems: a systems approach. Florida, CCR Press Inc.

Komar, P. D. and C. E. Reimers (1978). "Grain shape effects of settling rates." Journal of Geology, **86**: 193-209.

Kramer, K. J., H. A. Jenner and D. de Zwart (1989). "The valve movement response of mussels: a tool in biological monitoring." Hydrobiol. **188/189**: 433-443.

Krom, M. D., Berner, R. A (1981). "The diagenesis of phosphorus in a nearshore marine sediment." Geochimica Cosmochimica Acta **45**: 207-216.

Krost, P. (1990). "The impact of Otter-trawl fishery on nutrient release from the sediment and macrofauna of Kieler Butch (Western Baltic)." Ber Inst. Fur Meereskunde **Nr 200**.

Kutty, M. K. and B. N. Desai (1968). "A comparison of the efficiency of the bottom samplers used in benthic studies off Cochin." Mar. Biol. **1**: 168-171.

Labbé (1983). Contribution à l'étude de la dynamique d'exploitation du stock de

coquilles Saint-Jacques (*Pecten maximus*) en baie de Saint-Brieuc; DEA Océan. Biol. Paris, Univ Pierre et Marie Curie

Lagonegro, M. and E. Feoli (1986). Analisi multivariata dei dati. . Trieste, Libreria Goliardica

Laird, N. M. and J. H. Ware (1982). "Random-effects models for longitudinal data." Biometrics **38**: 963-974.

Lake, N. C. H., M. B. Jones and J. D. Paul (1987). "Crab predation on scallop (*Pecten maximus*) and its implication for scallop cultivation." Journal of the Marine Biological Association of the United Kingdom **67**: 55-64.

p/c dd

The feeding successes of four species of crabs (Crustacea: Brachyura) which are potential predators of the scallop *Pecten maximius* (L.) were studied under laboatory conditions. When provided with scallops of 4 and 5 cm shell height, *Liocarcinus depurator* (L.) did not consume any scallops whereas *Liocarcinus puber* (L.), *Carcinus maenas* (L.) and *Cancer pagurus* (L.) ate both size groupings but with varying success. The differences in the number of scallops eaten paralleled crab size such that *C. pagurus*, the species with the largest individuals (ca. 10.4 cm carapace width), ate the most, and small crabs (<5.5 cm carapace width), irrespective of species, ate none or very few scallops. Further experiments with *C. pagurus* and a wider size range of scallops (3-9 cm shell height) revealed the following trends: as prey size increased, the proportion of crabs feeding decreased and there was minimal predation on scallops >=7 cm shell height; male and female crabs showed similar predatory behaviour; and marine fouling on shells had no significant impact on crab feeding (X2 test, P> 0.05). These findings are discussed in relation to the potential for bottom culture of *P. maximus*.

Lambert, J. and P. Goudreau (1996). "Performance of the New England Hydraulic dredge for the harvest of Stimpson`s surf Clams (*Mactromeris polynyma*)." Can. Ind. Rep. Fish. Aquat. Sci **235: vii+**: 28p.

Lapointe, V. and B. Sainte-Marie (1992). "Currents, predators, and the aggregation of the gastropod *Buccinum undatum* around bait." Marine Ecology Progress Series **85** (3): 245-257.

Aggregation of the gastropod Buccinum undatum around bait was studied at 2 subtidal sites, with different current regimes, in the northern Gulf of Saint Lawrence, Canada. Time-lapse photography, SCUBA and current recordings were used to measure and interpret movement and behavior of whelks up to 25 m away from the bait. Objectives were to test the hypothesis of upstream movement to bait, and to determine relations between whelk arrival rate at the bait and currents and predators. In the absence of bait, 75.8% of whelks were static or buried. In the presence of bait, whelks in a 20 to 60 degree downstream sector to a maximum distance of 20 m moved towards the bait. Whelks apparently oriented to the bait by chemotaxis. Average crawling speed towards the bait varied from 7.3 to 15.1 cm/min and was independent of current speed. More whelks arrived at bait per unit time when current direction changed gradually than when current was directionally stable; this was due to exploitation

of new grounds and to depletion of the downstream population respectively.

Lart, W., R. Horton and R. Campbell (1997). Scallop dredge selectivity contribution of the tooth spacing, mesh and ring size; Part I. West of Scotland sea trials, Sea Fish Industry Authority.Seafish Report SR509

Lart, W. J., T. M. Dalby, P. H. MacMullen and P. F. Willerton (1993). Benthic and Ecosystem Impacts of Dredging for Pectinids, Commision of European Communities.Seafish CR No 71

Le Pennec, M. (1974). "Une novelle forme d'elevage margin: la pectiniculture." Penn. as Bed **2:(77)**: 328-341.

Le Pennec, M. and B. Diss-Mengus (1985). Rearing of *Chlamys varia* in commercial hatchery. 5th International Pectinid Workshop, La Coruña, Spain.

Leeder, M. R. (1982). Sedimentology, Process and Product, George Allen and Unwin.

Legendre, L. and P. Legendre (1984). Écologie numérique 2. Le traitement multiple des données écologiques, *Mason-Paris et Presses de L'Université du Québec-Canada*.

Leth, J. O. and A. Kuijpers (1996). Effects on the seabed sediment from beam trawling in the North Sea, Int. Coun. Explo. Sea

Lewis, R. I. and J. P. Thorpe (1994). Are queen scallops, *Aequipecten (Chlamys) opercularis* (L.), self recruiting? 9th International Pectinid Workshop, April 22-27, 1993, Nanaimo, B.C., Canada.

Light, J. M. (1988). "The status of *Chlamys varia* (L., 1758) and *Chlamys nivea* (MacGillivary, 1825); an appraisal using biometrics and geographical distribution." Journal of Conchology **33**: 31-41.

Lim, C. B., W. P. Low, S. F. Chew and Y. K. Ip (1996). "Survival of the intertidal pulmonate *Onchidium tumidium* during short term and long term anoxic stress." Mar. Biol. **125**: 707-713.

Lindeboom, H. J. and S. J. de Groot (1998). "The effects of different types of fisheries on the North Sea and Irish Sea benthic ecosystems." *NIOZ-Rapport 1998-1RIVO DLO report65 c003/98*: 404pp.

Livingstone, D. R. (1988). "Responses of microsomal NADPH- cytocrome c reductase activity and cytocrome P-450 in digestive glands of Mytilus edulis and Littorina littorea to environmental and experimental exposure to pollutants." Mar. Ecol. **46**: 37-43.

Livingstone, D. R., A. de Zwaan and T. R.J (1981). "Aerobic metabolism, octopine production and phosphoarginine as sources of energy in the phasic and catch adductor muscles of the giant scallop *Placopecten magellanicus* during swimming and the subsequent recovery period." Comp. Biochem. Physiol. **70B**: 35-44.

Livingstone, D. R., F. Lipps, P. Garcia Martinez and R. K. Pipe (1992). "Antioxidant

enzymes in the digestive gland of the common mussel, *Mytilus edulis*." Mar. Biol. **112**: 265-276.

Livingstone, D. R. and C. Nasci (2000). Biotrasformation and antioxidant enzymes as potential biomarkers of contaminant exposure in goby (*Zosterisesor ophiocephalus*) and mussel (*Mytilus galloprovincialis*) from the Venice Lagoon. The Venice Lagoon Ecosystem. Inputs and interactions between land and sea. Man and the Biosphere Series. P. Laserre and A. Marzollo. New York, The Parthenon Publishing Group. **25:** 357-373.

Lodeiros, C. J. M., R. I. Fernandez, A. Boumati, J. H. Himmelman and K. S. Chung (1996). " Relation of RNA/DNA ratios to growth for the scallop *Euvola (Pecten) ziczac* in suspended culture." Mar. Biol. **126**(2): 245-251.

Lojda, Z. (1977). "Studies on glycyl-proline naphthylamidase " I Lymphocytes. Histochem **54** 299-309.

Lojda, Z., R. Gossrau and T. H. Schiebler (1979). "Enzyme Histochemistry: A Laboratory Manual. Springer-Verlag, Berlin Heidelberg, New York ": pp. 340.

Lopez, C., M. J. Carballal, C. Azevedo and A. Villalba (1997). "Enzyme characterisation of the circulating haemocytes of the carpet shell clam, *Ruditapes decussatus* (Mollusca: bivalvia)." Fish Shellfish Immunol **7**: 595-608.

Lorenzen, C. J. (1967). "Determination of chlorophyll and phaeopigments: spectrometric equations." Limnol. Oceanogr **12**: 343-346.

Lowe, D. M. and L. Da Ros (2000). Cellular biomarkers of contaminants exposure and effect in mussel (*Mytilus galloprovincialis*) and goby (*Zosterisesor ophiocephalus*) from the Venice Lagoon. The Venice Lagoon Ecosystem. Inputs and interactions between land and sea. Man and the Biosphere Series. P. Laserre and A. Marzollo. New York, The Parthenon Publishing Group. **25:** 375-385.

Lowe, D. M., V. U. Fossato and M. H. Depledge (1995). "Contaminant-induced lysosomal membrane damage in blood cells of mussels *Mytilus galloprovincialis* from the Venice Lagoon: an in vitro study." Mar. Ecol. Prog. Ser., **129**: 188-196.

Lowe, D. M., C. Soverchia and M. N. Moore (1995). "Lysosomal membrane responses in the blood and digestive cells of mussels experimentally exposed to fluoranthene " Aquat. Toxicol., **33** 105-112.

Lowry, O. H., N. J. Rosebrough, F. A.L. and R. J. Randall (1951). "Protein measurement with the Folin Phenol reagent. ." J. Biol. Chem. **193**: 265-275.

Lubet, P. (1959). "Recherches sur le cycle sexuel et l'émission des gametes chez les mytilides et des pectinides (Mollusques bivalves)." Revue de Travaux de l'Institute des Pêches Maritimes, Nantes **23**(4): 387-548.

Lucas, A. (1982). "Evaluation of reproductive effort in bivalve molluscs." Malacologia **22** (1-1): 183-187.

Lucas, A. and P. G. Beninger (1985). "The use of physiological condition indices in marine bivalve aquaculture." Aquaculture, **44** 187-200.

Lyndon, G. (2000). New Zealand Seafood Industry Catch Sampling Programmes, New Zealand Seafood Industry Council Ltd (SeaFIC)

MacDonald, D. S. (1993). Ecological studies on the effects of scallop dredging on the benthos of the North Irish Sea. Liverpool.

Macleod, J. A. A., J. P. Thorpe and N. A. Duggan (1985). "A biochemical genetic study of population structure in queen scallop (*Chlamys opercularis*) stocks in the Northern Irish Sea." Marine Biology **87**: 77-82.

Madureira, M. J., A. M. Picado, A. M. Ferreira, E. Mendonca and Y. Le-Gal (1993.). PCB contamination in the oyster *Crassostrea angulata*: effects on lipids and adenylic energetic charge. Proceedings of the Second European Conference on Ecotoxicology 1993.

Magorrigan, B. H., M. Service and W. Clarke (1995). "An acoustic bottom classification survey of Strangford Lough, Northern Ireland." J. Mar. Biol. Ass. U.K. **75**: 987-992.

Maguire, J., A. A. Coleman, J. S. and G. M. Burnell (2002). "Effects of dredging on undersized scallops." Fisheries Research **56**(2): 155-165.

Maguire, J. A. and G. B. Burnell (2001). "The effect of stocking density in suspended culture on growth and carbohydrate content of the adductor muscle in two populations of the scallop (*Pecten maximus* L.) in Bantry Bay, Ireland." Aquaculture **198**(1-2): 95-108.

Maguire, J. A., P. Byrne, W. Lart and G. Burnell (2002). Towards sustainable scallop fisheries in Ireland. Achievement and Challenge. Rio + 10 and Ireland, Environmental Institute, UCD.

Maguire, J. A., D. Cashmore and G. M. Burnell (1999). "The effect of transportation on the juvenile scallop *Pecten maximus* (L.)." Aquaculture Res **30**: 325-333.

Maguire, J. A., P. G. Fleury and G. M. Burnell (1999). "Some methods for quantifying quality in the scallop *Pecten maximus* (L.)." J. of Shell. Res. **1**(18): 59-66.

Maguire, J. A., S. Jenkins and G. M. Burnell (2002). "The effects of repeated dredging and speed of tow on undersized scallops." Fisheries Research **58**(3): 367-377.

Maguire, J. A., D. A. O'Connor and G. M. Burnell (1999). "An investigation into behavioural indicators of stress in juvenile scallops." Aquaculture International **7**: 169-177.

Maguire, J. A., M. O'Donoghue, S. Jenkins, A. Brand and G. M. Burnell (2002). "Temporal and spatial variability in dredging induced stress in the great scallop *Pecten maximus* (L.)." The Journal of Shellfish Research **21**(1): 81-86.

Mahéo, R. (1968). "Observations sur l'anatomie et le functionnement de l'appareil byssogéne de *Chlamys varia* (L.)." Cahiers de Biologie Marine **9**(4): 373-379.

Main, J. and G. I. Sangster (1990). An assessment of scale damaged and survival rates of young gadoid fish escaping for the cod-end of a demersal trawl, Scottish Fisheries Research.Report 46

Maltby, L. (1999). "Studying stress: The importance of organism-level responses Ecological-Applications." Ecology Applied vol. **9**(2): 431-440.

Mantz, P. A. (1983). "Semi-empirical for fine and coarse cohesionless sediment transport." Proc Inst Civil Engrs. **75**(Mar): 1-33.

Marani, A., A. Maccaroni, R. Mamone, R. D'Ambra, Rampacci and M. L. Tancioni (1998). "Studio sulla distribuzione e valutazione della consistenza dei banchi di telline (Donax trunculs) nell'area marina prospiciente la Laguna di Lesina al fine di identificare appropriate misure gestionali della risorsa." Biologia Marina Mediterranea **5**(3): 428-436.

Marano, G., N. Casavola and C. Saracino (1980). "Indagine comparativa sulla riproduzione di *Chamelea gallina* (L.), *Venus verrucosa* (L.), *Rudicardium tuberculatum* (L.) nel Basso Adriatico." Memorie Biol. mar. Oceanogr **10 (Suppl.)**: 229-223.

Marano, G., R. Vaccarella, A. M. Pastorelli, V. De Zio, I. Rositani and P. Paparella (1998). "Valutazioni e consistenza dei banchi di *Chamelea gallina* (L.) e dei bivalvi commerciali associati nell'Adriatico Meridionale (anni 1984-1995)." Biologia Marina Mediterranea **5**(3): 407-417.

Marano, G., R. Vaccarella, A. M. Pastorelli, C. Piccinetti and D. Del Piero (1998). "Valutazione della biomassa di *Callista chione* (L.) (Fasolaro) in Adriatico." Biologia Marina Mediterranea **5**(3): 451-456.

Mariani, A., A. Maccaroni, R. Mamone, M. Dell'Aquila, D. Fezzardi and A. Cerasi (1998). "Studio sulla biologia e distribuzione del cannolicchio (*Ensis siliqua minor*) nei Compartimenti marittimi di Roma, Gaeta, Napoli e Salerno." Biologia Marina Mediterranea **5**(3): 457-462.

Marigomez, I., M. P. Cajaraville and E. Angulo (1990). "Histopathology of the digestive gland/gonad complex of the marine prosobranch *Littorina littorina* exposed to cadmium." Dis. Aquat. Org. **9**: 229-238.

Marin, M. G., V. Moschino, P. D. M, N. Nesto, M. Deppieri, L. Carotenuto, L. Ballarin, C. Nasci, S. Casellato and L. Da Ros (2001). First attempts in evaluating the effects of hydraulic dredging on the target species *Chamelea gallina*: physiological responses and shell damage. 36th European Marine Biology Symposium, Maò- Menorca.

Marin, M. G., V. Moschino, F. Meneghetti, N. Nesto and L. Da Ros (2003). Effects of mechanical stress in under-sized clams, *Chamelea gallina* and *Tapes philippinarum*:

a laboratory approach. International Workshop on Sustainable Aquaculture, Animal Welfare, Human Health and Interactions with the Environment, Certosa di Pontignano, Siena.

Marin, M. G., V. Moschino, D. Pampanin, N. Nesto, M. Deppieri, L. Carotenuto, L. Ballarin, S. Cassellato and L. Da Ros (in prep). " Effects of hydraulic dredging on the target species *Chamelea gallina*: physiological responses and shell damage." J. Mar. Biol. Assoc. U.K.

Marin, M. G., N. Nesto and L. Da Ros (2001). Evaluation of biological stress indices in *Tapes philippinarum* from the lagoon of Venice through monitoring of natural populations and transplantation experiments. Mediterranean Ecosystems: Structures and Processes. F. M. Faranda and L. S. Guglielmo, G,. Italy, Springer-Verlag**:** 91-94.

Mason, J. (1957). "The age and growth of the scallop, Pecten maximus (L.), in Manx waters." Journal of the Marine Biological Association of the United Kingdom **36**: 473-492.

Mason, J. (1958). "The breeding of the scallop, *Pecten maximus*, in Manx waters." Journal of the Marine Biological Association of the United Kingdom **37**: 653-671.

Mason, J. (1958). "A possible lunar periodicity in the breeding of the scallop, *Pecten maximus* (L.)." Annals and Magazine of Natural History **Series B 1**: 601-602.

Mason, J. (1969). The growth of spat of *Pecten maximus* (L.), International Council for the Exploration of the Sea, Shellfish and Benthos Committee Meeting Paper.CM 1969, Doc No K: 32

Mason, J. (1983). Scallop and queen fisheries in the British Isles. Farnham (U.K.), Fishing News Books Ltd (Buckland Foundation).

Mason, J., C. J. Chapman and J. A. M. Kinnear (1979). Population abundance and dredge efficiency studies on the scallop, *Pecten maximus* (L.). In : Population assessment of shellfish stocks.

Mason, J. and J. S. Colman (1955). Note on a short-term marking experiment on the scallop *Pecten maximus* (L.) in the Isle of Man, University of Liverpool.67

Mattei, N. and M. Pellizzato (1997). Mollusk fisheries and aquaculture in Italy, NOAA.129,3

Mayer, F. L., D. J. Versteeg, M. J. McKee, L. C. Folmar, R. L. Graney, D. C. McCume and B. A. Rattner (1992). Physiological and nonspecific biomarkers. . Biomarkers: Biochemical, Physiological and Histological Markers of Anthropogenic Stress R. J. Huggett, R. A. Kimerle, P. M. J. Mehrle and H. L. Bergman. Boca Raton: 5-85., Lewis Publisher

Mayer, L. M., S. D.F, R. H. Findlay and D. L. Rice (1991). "Effects of commercial dragging on sedimentary organic matter." Mar Environ Res **31**: 249-261.

McCarthy, J. F. and L. R. Shugart (1990). Biomarkers of environmental contamination. .

Boca Raton, Florida, , Lewis

McKillup, S. C. and R. V. McKillup (1994). " The decision to feed by a scavenger in relation to the risk of predation and starvation." Oecologia **97**(1): 41-48.

McKyes, E. and O. S. Ali (1977). "The cutting of soil by narrow blades." Journal of Terramechanics **14**(2): 43-58.

McLoughlin, R. J., P. Young, R. Martin and J. Parslow (1991). "The Australian scallop dredge: estimates of catching efficiency and associated indirect fishing mortality." Fish Res **11**: 1-24.

McQuinn, I. H., Gendron, L., Himmelman, J.H. (1988). "Area of attraction and effective area fished by whelk (Bucinum undatum) trap under variable conditions." Can. J. Fish. Aquat. Sci **45**: 2054-2060.

Medcof, J. and J. F. Caddy (1971). "Underwater observations on performance of clam dredges of three types." ICES C.M. 1971/B:10: 7p.

Medcof, J. C. and N. Bourne (1964). "Causes of mortality of the sea scallop, *Placopecten magellanicus*." Proceedings of the National Shellfisheries Association **53**: 33-50.

Causes of natural mortality include summer water temperatures too low for spawning or for larval development, flushing of basins by "tropic tides", lethal saltations in summer water temperature, predators and shell pests. Mass mortalities due to pathogenic micro-organisms are not known. Causes of fishing mortality include bottom damage by dragging, damage by turbulence in drags, dumping on deck, culling, shovelling, air exposure and shucking. Fouling of beds by discarded rims, and pressure changes, probably are not causes of mortality. Natural mortality has been estimated as 10% for adult scallops but there is no reliable figure. Present methods destroy 10% of discards (scallops returned to bottom) off Digby, Nova Scotia, and 2-20% on Georges Bank due to practices resulting in long air exposure and much mechanical damage. Dickie (1955) estimated that 20% of the scallops off Digby were removed each year by fishing (dragging). There is no satisfactory estimate of direct fishing mortality for Georges Bank.

Melhuish, M. (1995). The Scalloper's Handbook.

Melo, J. L. B. S. (1989). "Caracterização Hidro-oceanográfica da Ria Formosa." Anais Inst. Hidrog **nº10**: 7-23.

Messieh , S. N., T. D. Rowell, D. L. Peer and P. J. Cranford (1991). "The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shel seabed." Continental Shelf Research **11**: 1237-1263.

Meyer, T. L., R. A. Cooper and K. J. Pecci (1981). "The performance and environment effects of a hydraulic dredge." Marine Fisheries Review **43**(9): 14-22.

Michael, K. P., G. P. Olsen, B. T. Hvid and H. J. Cranfield (1990). "Design and performance of two hydraulic subtidal clam dredges in the New Zealand." New Zealand

Fis. Tech **Rep. 21**: 16p.

Millar, R. B. (1991). "Estimating the size-selectivity of fishing gear by conditioning on the toal catch : The SELECT (Share Each Lengthclass's Catch Tota) model." Counc. Meet. of the Int. Counc. for Expl. of the Sea, La Rochelle (France), ICES-CM-1991/B **57**: 21p.

Millar, R. B. (1992). "Estimating the size-selectivity of fishing gear by conditioning on the total catch." Journal of the American Statistical Association **87**: 962-968.

Millar, R. B. and R. J. Fryer (1999). "Estimating the size-selection curves of towed gear, traps, nets and hooks." Reviews in Fish Biology and Fisheries **9**: 1-28.

Miller, M. C., I. N. McCave and P. D. Komar (1977). "Threshold of sediment motion under unidirectional currents." Sedimentology **24**: 507-527.

Miller, M. C., I. N. McCave and P. D. Komar (1977). "Threshold of sediment motion under unidirectional currents." Sedimentology **24**: 507-527.

Miller, R. J. (1978). "Entry of Cancer products to baited traps." J. Cons. Int. Explor. Mer **38**: 220-225.

Millward, A. and M. A. Whyte (1992). "The hydrodynamic characteristics of six scallops of the Super Family Pectinacea, Class Bivalvia." Journal of Zoology, London **227**: 547-566.

Minchin, D. (1978). The behaviour of young escallops (*Pecten maximus* (L.) (Pectinidae). 2nd International Pectinid Workshop, Brest, France, 8-13 May 1978.

Minchin, D. (1981). "The escallop *Pecten maximus* in Mulroy Bay." Fisheries Bulletin, Dublin **1**: 21pp.

Minchin, D. (1991). Decapod predation and the sowing of the scallop *Pecten maximus* (Linnaeus 1758). An international compendium of scallop biology and culture. S. E. Shumway and P. A. Sandifer. Baton Rouge, World Aquaculture Society**:** 191-197.

Minchin, D. (1992). "Biological observations on young scallops, *Pecten maximus*." J. Mar. Biol. Assoc. U.K. **72**: 807-819.

Minchin, D. (1992). "Induced spawning of the scallop, *Pecten maximus*, in the sea." Aquaculture **101**(1-2): 187-190.

Scallops (Pecten maximus) held within lantern nets, at depths exceeding 16 m for 35-129 days in two deep water bays, spawned when raised near the sea surface in June or July. All four attempts produced spawning scallops following a 1.1-2.4 degree C rise in temperature.

Minchin, D., C. B. Duggan and W. King (1987). "Possible effects of organotins on scallop recruitment." Marine Pollution Bulletin **18**(11): 604-608.

The adult populations of the scallop (Pecten maximus) and of flame shells (Lima hians) have declined in the North Water of Mulroy Bay on the north coast of Ireland. Settlements of these and some other bivalve species either failed or

were reduced. These events relate well to the first introduction and subsequent increased use of organotin net-dips on salmonid farms in this Bay. The last use of these net-dips was during the spring of 1985. In 1986 there was a good settlement of scallops, and settlements of other bivalves were recorded except for flame shells. Levels of TBT in adult scallop tissue in the North Water are high, 0.7 mu g g super(-1) wet wt; levels determined in other species were much lower.

Minchin, D., H. Skjaeggestad, G. A. Haugum and O. Strand (2000). "Righting and recessing ability of wild and native cultivated scallops." Aquaculture Research **31**(5): 473-474.

Ministero delle Risorse Agricole Alimentari e Forestali (1996). Risorsa Molluschi. A cura del C.I.R.S.P.E**:** 86pp.

Ministero delle Risorse Agricole Alimentari e Forestali (1998). "Risorsa Molluschi a cura del C.I.R.S.P.E."

Ministero per le Politiche Agricole (1998). "Piano Vongole 1998 (Legge 164/98)."

Ministero per le Politiche Agricole (1998). "Decreto Ministeriale 21 luglio 1998."

Mizzan, L. (1992). "Malacocenosi e faune associate in due stazioni altoadriatiche a substrati solidi." Boll. Mus. civ. Stor. nat. Venezia **41**: 7-54.

Moal, J., J. R. Le Coz, J. F. Samain and J. Y. Daniel (1989). " Nucleotides in bivalves: extraction and analysis by high performance liquid chromatography (HPLC)." Comparative Biochemistry and Physiology. **93B**(2): 307-316.

Moal, J., J. R. Le Coz, J. F. Samain and J. Y. Daniel (1989). "Responses and adaptations of adenylate energy charge and digestive enzyme activities to tidal emersion of *Crassostrea gigas* population in Marennes - Oleron Bay." Sci. Mar. Barc **53**(2-3): 699-704.

Moal, J., J. R. Le Coz, J. F. Samain, J. Y. Daniel and A. Bodoy (1991). "Oyster adenylate energy charge: response to levels of food." Aquat. Living Resour. **4**: 133-138.

Moita, I. (1986). "Plataforma continental. Carta dos sedimentos superficiais." Notícia explicativa da folha SED 7 e 8 **Inst. Hidro**: 18pp.

Moloney, W. C., K. McPherson and L. Fliegelman (1960). "Esterase activity in leukocytes and demonstrated by the use of naphtol AS-D chloroacetate substrate. ." J Histochem Cytoc **8** 200-207.

Moore, C. A. and D. M. Lowe (1977). "The cytology and cytochemistry of the hemocytes of *Mytilus edulis* and their responses to experimentally injected carbon particles." J Invertebr Pathol **29**: 18-30.

Moore, M. N. (1976). "Cytochemical demonstration of latency of lisosomal hydrolases in digestive cells of the common mussel, *Mytilus edulis*, and changes induced by thermal stress." Cell.Tiss. Res. **175**: 279-287.

Moore, M. N. (1990). "Lysosomal cytochemistry in marine environmental monitoring. ." Histochem. J. **22**: 187-191.

Mortimer, R. J. G., J. T. Davey, M. D. Krom, P. G. Watson, P. E. Frickers and R. J. Clifton (1999). "The effect of macrofauna on porewater profiles and nutrient fluxes in the intertidal zone of the Humber Estuary." Estuarine, Coastal and Shelf Science, **48**: 683-699.

Moschino, V., M. Deppieri and M. M. G (2003). " Evaluation of shell damage to the clam *Chamelea gallina* captured by hydraulic dredging in the Northern Adriatic Sea." ICES J. Mar. Sci. **60**: 393-401.

Moschino, V., M. Deppieri and M. G. Marin (2001). Valutazione degli effetti dello stress da pesca con draga idraulica sulla vongola Chamelea gallina. XXXII Congresso della Società Italiana di Biologia Marina (S.I.B.M.), Numana.

Moschino, V., M. Deppieri and M. G. Marin (2002). " Evaluation of the effects of stress caused by hydraulic dredging on the clam *Chamelea gallina*." Biol. Mar. Medit. **9**(1): 247-250.

Munro, C. (1992). An investigation into the effects of scallop dredging in Lyme Bay., Devon Wildlife Trust

Murawski, A. S. and F. M. Serchuck (1989). Environmental effects of offshore dredge fisheries for bivalves. Copenhagen, ICES.-CM-K27

Murawski, S. A., R. Brown, H.-L. Lai, P. J. Rago and L. Hendrickson (2000). "Large-scale closed areas as a fishery-management tool in temperate marine systems: the Georges Bank experience." Bulletin of Marine Science **66**(3): 775-798.

14-fold increase exploitable biomass in 4 years

Murawski, S. A. and F. M. Serchuk (1989). Environmental effects of offshore dredge fisheries for bivalves. Copenhagen, Denmark, International Council for the Exploration of the Seas.ICES CM 1989/K:27

During 1986 and 1987, we conducted submersible observations and associated experiments studying offshore dredge fisheries for scallops and clams in the Mid-Atlantic region off the northeast USA. Objectives of the project were to (1) evaluate the effects of commercial fishing operations on incidental mortality (gear-induced damage) of sea scallops (Placopecten magellanicus), ocean quahogs (Artica islandica) and surf clams (Spisula solidissima); (2) assess the acute mortality rates of these species when dredged by commercial vessels and subsequently discarded as undersized; and (3) observe the general environmental effects of the offshore dredge fisheries for these shellfish. We conclude that, in the Mid-Atlantic region, harvest efficiency of commercial dredges is generally high, there is variable damage among species encountered by the dredges but not retained, and there are variable survival rates of small clams and scallops returned to the sea bed as undersized.

Murphy, E. J. (1983). A mark-release-recapture experiment on Manx scallop (Pecten maximus (L.)) beds for the estimation of mortality rates. 4th International Pectinid

Workshop, Aberdeen, Scotland.

Murphy, E. J. (1986). An investigation of the population dynamics of the exploited scallop, *Pecten maximus* (L.), in the North Irish Sea., University of Liverpool.

Naidu, K. S. (1988). "Estimating mortality rates in the Iceland scallop, *Chlamys islandica* (O.F. Muller)." J. Shell. Res **7**: 61-71.

Najai, S. and Ktari. (1979). "Fishing mortality and yield per recruit of the red mullet *Mullus barbatus* of Tunisia." Mar. Life **5**(2): 35.

Nashimoto, K. (1984). "The selectivity of sunary surf clam dredge." Bulletin of the Japanese Society of Scientific Fisheries Nissuuishi **50**: 1145-1155.

Nashimoto, K. (1985). "The selectivity of the Japanese surf clam dredge." Bulletin of the Japanese Society of Scientific Fisheries Nissuuishi **51**(3): 419-423.

Nashimoto, K., H. Miyzawa and T. Hiraishi (1983). "The tooth selectivity of the Japanese surf clam dredge. Bulletin of the Japanese Society of Scientific Fisheries Nissuuishi." **49**(3): 379-385.

Newell, R. C., Seiderer, L.J., Hitchcock D.R. (1998). "The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed." Oceanography and Marine Biology: an Review **36**: 127-177.

Nielson, J. D., Waiwood K.G, Smith S.J. (1989). "Survival of Atlantic Halibut (*Hipoglossus hippoglossus*) caught by long line and otter trawl gear." Can J Fish Aquat Sci **46**: 887-897.

Niven, R. K. and N. Khalili (1998). "In situ fluidisation by a single internal vertical jet." Journal of Hydraulic Research **36**(No 2): 199-228.

Nixon, S. W. (1981). "Remineralization and nutrient cycling in coastal marine ecosystems. In: B.W. Nelson and L.E. Cronin (Editors)." Nutrient Enrichment in Estuaries. Hermana: 111-138.

Nojima, S., G.F. Russo (1980). "Indagine comparativa sulla riproduzione di Chamelea gallina (L.), Venus verrucosa (L.), Rudicardium tuberculatum (L.) nel Basso Adriatico." Memorie Biol. mar. Oceanogr., **10 (suppl.)**: 229-233.

Nojima, S. and G. F. Russo (1989). "Struttura di popolazione di bivalve *Chamelea (Venus) gallina* (L.)." Oebalia **XV**: 189-201.

Okubo, A. (1980). "Diffusion and ecological problems: mathematical models." Springler-Verlag, New York.

Ordas, M. C., B. Novoa and F. A (1999). "Phagocytosis inhibition of clam and mussel haemocytes by *Perkinsus atlanticus* secretion products." Fish Shellfish Immunol. **9**: 491-503.

Orel, G. and D. Del Piero (1988). "Relazione sulle ricerche condotte sullo stocks di *Chamelea gallina* nel Golfo di Trieste. Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano nella pesca e l'acquacoltura." **1**: 321-336.

Orel, G., R. Marocco, E. Vio, D. P. D and G. Della Seta (1987). "Sedimenti e biocenosi bentiche tra la foce del Po ed il Golfo di Trieste (Alto Adriatico)." Bull. Ecol. **18**: 229-241.

Orel, G., E. Vio and F. Aleffi (1989). "Biocenosi bentoniche e loro modificazioni in seguito a stress anossici. In Curzi, P.V., F. Tombolini (Eds)." Atti Convegno Nazionale per la Difesa dell'Adriatico, Ancona: 59-63.

Orel, G., E. Vio and D. Del Piero (1989). "Considerazioni preliminari sui popolamenti bentonici dell'Alto Adriatico studiati durante le crociere ASCOP." Boll. Ocean. Teor. Appl.: 193-197.

Orlic, M., M. Gacic and P. E. La Violette (1992). "The currents and circulation of the Adriatic Sea." Oceanologica Acta **15**(2): 109-124.

Ottaviani, E., A. Franchini, D. Barbieri and K. D (1998). "Comparative and morphofunctional studies on *Mytilus galloprovincialis* hemocytes: presence of two aging-related hamocytes stages." Ital J Zool **65**: 349-354.

Page, D. S., J. Widdows and F. J. Staff (1998). "Effects of thermal stress and Tri(n) Butyl
Tin on anaerobic energy metabolism in *Mytilus edulis.*" Mar. Environ. Res. **46**: 433-437.

Palmer, D. W. (in prep). The Western Channel Fishery for scallops (*Pecten maximus*) 1970-99, CEFAS Technical Report

Paloheimo, J. E. and E. Cadima (1964). "On statistics of mesh selection." *ICNAF* Serial nº 1394/Doc. nº98.

Pampanin, D. M., A. M. Amaral, M. A. Chícharo and M. G. Marin (2001). "Effects of anoxia on DNA, RNA and protein contents in the venus clam *Chamelea gallina*." Ital. J. Biochem. **50**: 59-61.

Pampanin, D. M., L. Ballarin, L. Carotenuto and M. G. Marin (2002). "Air exposure and functionality of *Chamelea gallina* haemocytes: effects on haematocrit , adhesion, phagocytosis and enzyme contents." Comp. Biochem. Physiol. A **131**: 605- 614.

Pampanin, D. M., L. Carotenuto, L. Ballarin and M. M. G (2000). Effects of anoxia on functionality of *Chamelea gallina* haemocytes. European Society for Comparative Physiology and Biochemistry, 21st Congress: Comp. Biochem. Physiol., part A,, Liege-Belgium.

Pampanin, D. M., M. G. Marin and L. Ballarin (2000). Caratterizzazione morfo-

funzionale degli emociti di *Chamelea gallina*. 61° Congr. U.Z.I.,, S. Benedetto del Tronto,.

Pampanin, D. M., M. G. Marin and L. Ballarin (2002). " Morphological and cytoenzymatic characterisation of haemocytes of the venus clam *Chamelea gallina*." Dis. Aquat. Org **49**: 227-234.

Panara, F., I. Di Rosa, A. Fagotti, F. Simoncelli, C. Mangiabene, R. K. Pipe and R. Pascolini (1996). "Characterization and immunohistochemical localization of actin and fibronectin in haemocytes of the mussel *Mytilus galloprovincialis*." Histochem. J. **28**: 123-131.

Paolini, M., C. Piccinetti and G. Piccinetti Manfrin (1998). "Stock di vongole (*Chamelea gallina* L.) nel Compartimento marittimo di Ravenna (1984-1997)." Biologia Marina Mediterranea **5**(3): 400-406.

Paolini, M., C. Piccinetti and S. Soro (1998). "Stock di vongole (*Chamelea gallina*, L.) nel Compartimento maritttimo di Pesaro (1984-1995)." Biologia Marina Mediterranea **5** (2): 404-411.

Paon, L. A. and E. L. R. Kenchington (1995). "Changes in somatic and reproductive tissues during artificial conditioning of the sea scallop, *Placopecten magellanicus* (Gmelin, 1791)." J. Shellfish Res. **14(1)**: 53-58.

Paul, J. D. (1978). The biology of the queen scallop, Chlamys opercularis (L.) in relation to its prospective cultivation, University of Liverpool.

Pearson, W. H., D. L. Woodruff, P. C. Sugarman and O. B.L (1981). "Effects of oiled sediment on predation on the littleneck clam, *Protothaca staminea*, by the Dungeness crab, *Cancer magister*." Estuar. Coastl. Shelf. Sci **13**: 445-454.

Pechenik, J. A. (1999). "On the advantages and disadvantages of larval stages in benthic marine invertebrate life cycles." Mar Ecol Prog Ser **177**: 269-297.

Pelletier, E., S. Ouellet and M. Paquet (1991). "Long term chemical and cytochemical assessment of oil contamination in estuarine intertidal sediments." Mar. Poll. Bull. **22**(6): 273-281.

Pellizzato, M., M. Cornello, D. Folin, M. Grim, M. Libralato, N. Nesto, R. Rocco, R. E. Trigg and A. Vendramini (1998). "Sperimentazione della gestione dei banchi naturali di molluschi bivalvi della specie *Chamelea gallina* (L.) nei compartimenti marittimi di Venezia e Monfalcone (Nord Adriatico) (periodo Novembre 1997 - Aprile 1998)." Biologia Marina Mediterranea **5**(3): 385-394.

Pellizzato, M. and E. Giorgiutti (1997). Attrezzi e sistemi di pesca nella provincia di Venezia. Provincia di Venezia. Venezia, A.S.A.P.

Perès, J. M. and J. Picard (1964). " Nouveau manuel de benthique de la Mer Méditerranée." Rec. St. Mar. Endoume **31**: 3-17.

Perez-Comas, J. A., Skalski J.R. (1996). "A parametric multinomial model for size

selection in alternate-haul experiments." Fisheries Research **27**(1-3): 113-129.

Peronnet, I. (1995). Estimation of discards by the French Trawler fleet fishing in the Celtic Sea and the Bay of Biscay. Assessment of discarding rates for commercial species of fish: final report to the Commission of the European Communities: Contract Ref. BIOECO/93/003. J. Cotter, CEFAS Lowestoft.

Peterson, C. H., H. C. Summerson and S. R. Fegley (1987). "Ecological consequences of mechanical harvesting of clams." Fish Bull US **85**: 281-298.

Phelps, H. L. (1989). "Clam burrowing bioassay for estuarine sediment " Bull. Environ. Contam. Toxicol., **43** 838-845.

Phelps, H. L., J. T. Hardy, W. H. Pearson and C. W. Apts (1983). "Clam burrowing behaviour: Inhibition by copper-enriched sediment." Mar. Poll. Bull. **14**(12): 452-455.

Phelps, H. L., W. H. Pearson and J. T. Hardy (1985). "Clam burrowing behaviour and mortality related to sediment copper " Mar. Poll. Bull., **16** (8): 309-313.

Piboubes, R. (1974). "Pêche et conchyliculture en Bretagne Nord. Première partie." Bulletin C.E.R.S **4**: 30-150.

Picado, A. M., C. Sylvestre, M. C. Penada and Y. Le Gal (1988). "Evaluation de la charge énergétique adénylique du bivalve *Cardium* sp. Dans l'estuaire du Sado (Portugal)." Oceanis **14**: 479-486.

Piccinetti, C. (1988). "La pesca delle vongole in Adriatico. Valutazione dello stocks di vongole nei compartimenti marittimi di Rimini e Ravenna." Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano per la pesca e l'acquacoltura **1**: 337-350.

Pingree, R. D. and K. D. Griffiths (1978). "Tidal fronts on the shelf seas around the British Isles." Journal of Geophysical Research **83**: 4615-4622.

Pipe, R. K. (1990). "Hydrolytic enzymes associated with the granular haemocytes of the marine mussel *Mytilus edulis*." Histochem **22**: 595-603.

Pipe, R. K., J. A. Coles, M. E. Thomas, V. U. Fossato and A. L. Pulsford (1995). "Evidence for environmentally derived immunomodulation in mussels from the Venice Lagoon " Aquat. Toxicol **32** 59-73.

Pope, J. A., A. R. Margetts, J. M. Hamley and E. F. Akyuz (1975). "Manual of methods for fish stock assessement, Part III. Selectivity of fishing gear." FAO Fisheries Technical Papers: 41, 65 pp.

Poppe, G. T., Goto, Y. (1993). "European Seashells. Vol II (Scaphopoda, Bivalvia e Cephalopoda)." Verlag Christa Hemmen, Germany: 221 pp.

Postma, H. (1967). Sediment transport and sedimentation in the estuarine environment. Estuaries, Amer. Assoc. Adv. Sci. Pub. G. Lauff**:** 158-179.

Pranovi, F., O. Giovanardi, G. Franceschini (1998). "Recolonization dynamics in areas disturbed by bottom fishing gears." Hydrobiologia **375-376**: 125-135.

Pranovi, F. and O. Giovanardi (1994). "The impact of hydraulic dredging for short-necked clams, *Tapes spp.*, on a infauna community in the lagoon of Venice." Sci. Mar **58**(4): 345-353.

Pranovi, F., S. Raicevich, G. Franceschini, M. G. Farrace and O. Giovanardi (2000). "Rapido trawling in the northern Adriatic Sea: effects on benthic communities in an experimental area." ICES Journal of Marine Science **57**: 1-8.

Préfecture de la Région Bretagne, D. R. d. A. M. (1999). "Arrêté n 234/97 portant approbation de la libération n117/99 du 28 septenbre 1999 du comité régional des pêches maritimes et des élevages marins de Bretagne portant création et fixant les conditions d'attribution de la licence de pêche aux coquilles Saint Jacques, aux praires et aux pétoncles dans le secteur de Brest-Camaret." Article 9 : p. 3.

Prena, J., Rowell, T. W., Schwinghamer, P., Gilkinson, K., Gordon, D. C. (1996). "Grand Banks otter trawling impact experiment: 1. Site selection process, with a description of macrofaunal communities." Canadian Technical Report of Fisheries and Aquatic Sciences **2094**: 38p.

Prioli, G., F. Fiori and N. Mietto (1998). "Sperimentazione della gestione dei molluschi bivalvi nel compartimento di Chioggia." Biol. Mar. Medit. **5**(3): 418-427.

Quéro, J. C. and J. J. Vayne (1998). "Les fruits de la mer et des plantes marines des peches françaises." Edition Ifremer: 256 pages.

Rabitti, S. and A. Boldrin (1979). Sedimentologia di dettaglio della zona antistante il litorale di Chioggia (Venezia). Atti del Congresso Scientifico Nazionale Progetto Finalizzato Oceanografia e Fondi Marini.

Rajaratnam, N., O. Aderibigbe and D. Pochylko (1995). "Erosion of sand beds by oblique plane water jets." Proceedings of the Instutute of Civil Engineers, Water, Maritime and Energy **112**: 31-38.

Rajaratnam, N. and S. Beltaos (1977). " Erosion by Impinging Circular Turbulent Jets." Journal of Hydraulics Division, ASCE, **HY10**: 1191-1205.

Ramsay, K., M. Kaiser and R. Hughes (1996). "Changes in hermit crab feeding patterns in response to trawling disturbance." Mar. Ecol. Prog. Ser **144**(Mar. Ecol. Prog. Ser.): 63-72.

Ramsay, K. and M. J. Kaiser (1998). "Demersal fishing disturbance increases predation risk for whelks (*Buccinum undatum* L.)." J. Sea. Res **39**: 299-304.

Ramsay, K., M. J. Kaiser and R. N. Hughes (1997). "A field study of intraspecific competition for food in hermit crabs (*Pagurus bernhardus*)." Estuarine, coastal and shelf science **44**: 213-220.

Ramsay, K., M. J. Kaiser and R. N. Hughes (1998). "Responses of benthic scavengers

to fishing disturbance by towed gears in different habitats." Journal of Experimental Marine Biology and Ecology **224**(1): 73-89.

Ramsay, K., M. J. Kaiser, P. G. Moore and R. N. Hughes (1997). "Consumption of fisheries discards by benthic scavengers: utilization of energy subsidies in different marine habitats." J. anim. ecol. **66**: 884-896.

Ramsay, K., M. J. Kaiser, P. G. Moore and R. N. Hughes (1997). "Consumption of fisheries discards by benthic scavengers: utilization of energy subsidies in different marine habitats." Journal of Animal Ecology **66**(6): 884-896.

1. Man has increased the input of carrion to marine communities worldwide through the practice of discarding fisheries-derived material. A large proportion of discarded material sinks to the sea bed and becomes available to benthic scavengers. Carrion from fisheries discards will subsidize marine food webs, which can sometimes result in the enhancement of consumer populations. 2. This study examines the benthic scavengers that feed on fisheries discards in three habitats in the Irish Sea. We investigated the relationship between the abundance of scavengers feeding on carrion in terms of numbers of each species and the density of those scavenger species in the surrounding area. 3. Observations with bailed time-lapse cameras at a site offshore From Anglesey showed that the hermit crab Pagurus bernhardus was attracted to carrion in greatest abundance and aggregated at densities oi up to 330 m(-2). At Red Wharf Bag. a wider range of species was observed: starfish Asterias rubens, hermit crabs P. bernhardus, whelks Buccinum undatum and swimming crabs Liocarcinus spp. There was relatively little scavenging activity at the Walney Island site where the edible crab Cancer pagurus appeared to consume the greatest proportion of the carrion. 4. Numbers of each scavenger species at the bait were only partially related to the background population density of each species at each site. The rate of consumption of carrion varied between sites and could be related to the abundance of different scavenger species at the bait. 5. Baited traps were used to investigate those benthic scavengers that were too small to be observed by time-lapse photography. The traps caught a variety of amphipod and isopod species. Some species were habitat-specific, whereas others were ubiquitous, but specialized in eating a particular type of carrion; for example, Orchomene nanus, which was only caught in traps baited with crab. 6. The results demonstrated that the responses of scavengers to fisheries discards varied between different habitats. The responses of hermit crabs, P. bernhardus, were particularly variable, with large aggregations oi. individuals occurring at one site but not at others, despite similar background population densities.

Ramster, J. W. and H. W. Hill (1969). "Current systems in the northern Irish Sea." Nature **224**: 59-61.

Rauck, G. (1989). "What are the effects of bottom trawls on sea-bottom and zoobenthos?." Fischerblatt **37**: 155-158.

Redant, F. (1987). "A bibliography on the effects of bottom fishing gear and harvesting techniques on benthic biota." Benthos Ecology Working Group, International Council for the Exploration of the Sea **C. M. 1987/L:26**: 27 pp.

Reddiah, K. (1962). "The sexuality and spawning of Manx pectinids." Journal of the

Marine Biological Association of the U.K. **42**: 683-703.

Reeves, S. A., D. W. Armtrong, R. J. Fryer and K. A. Coull (1992). "The effects of mesh size, cod-end extension and cod-end diameter on the selectivity of Scottish trawls and seines." ICES Journal of Marine Science **49**: 279-288.

Regoli, F., G. W. Winston, V. Mastrangelo, G. Principato and S. Bompadre (1998). "Total oxyradical scavenging capacity in mussel *Mytilus* sp. as a new index of biological resistance to oxidative stress." Chemosphere **37**(14-15): 2773-2783.

Reise, K. and A. Schubert (1987). "Macrobenthic turnover in the subtidal Wadden Sea: The Norderaue revisited after 60 years." Helgol Meeresunters **41**: 69-82.

Renwrantz, L. and A. Stahmer (1983). "Opsonizing properties of an isolated hemolymph agglutinin and demonstration of lectin-like recognition molecules at the surface of hemocytes from *Mytilus edulis*." J Comp Physiol **146**: 535-546.

Riedl, R. (1991). "Fauna e Flora del Mediterraneo. Dalle alghe ai mammiferi: una guida sistematica alle specie che vivono nel Mar Mediterraneo." Franco Muzzio Editore: 311-336.

Rield, R. (1986). Fauna y flora del mar Mediterráneo. Barcelona, Ediciones Omega S. A.

Riemann, B. and E. Hoffmann (1991). "Ecological consequences of dredging and bottom trawling in the Limfjord, Denmark." Mar. Ecol. Prog. Ser **69**: 171-178.

Roberts, C. D. (1975). "Investigations into a *Modiolus modiolus* (L.) (Mollusca; Bivalvia) community in Strangford Lough, N. Ireland." Report of the Underwater Association **1**: 27-45.

Robinson, R. F. and C. A. Richardson (1998). "The direct and indirect effects of suction dredging on a razor clam (*Ensis arcuatus*) population." ICES Journal of Marine Science **55**: 970-977.

Robinson, S. M. and D. Ware (1988). "Ontogenetic development of growth rates in larval Pacific herring, *Clupea harengus pallasi*, measured with RNA/DNA ratios in the Strait of Georgia, British Columbia." Can. J. Fish. Aquat. Sci. **45**: 1422-1429.

Rodhouse, P. G. and G. M. Burnell (1979). *In situ* studies on the scallop *Chlamys varia*. Progress in Underwater Science. J. C. Gamble and J. D. George, Pentech Press, Plymouth. **4 (N.S.):** 87-98.

Five populations of C. varia , on the west coast of Ireland were sampled by diving. Growth in trays was investigated and an experiment was performed on the artificial collection of spat. Population density differed between sites and greatest length occurred where densities were lowest. Growth in trays at Ballynakill Harbour could be approximated by the Bertalanffy model. The growth curve estimated from checks on shells from the natural population at the same site was comparable with that obtained from the tray experiment. Spat were successfully collected on monofilament nylon held off the bottom in onion bags.

Best results were obtained in enclosed bays and their appear to be 2 major spatfalls during the summer.

Rogan, E., S. C. Culloty, T. Cross and M. Mulcahy (1991). "The detection of *Bonamia ostreae* (Pinchot et al. 1980) in frozen oysters (*Ostrea edulis* L.) and the effect of the parasite on condition." Aquaculture **97**: 311-315.

Rolfe, M. S. (1973). Notes on queen scallops and how to catch them. Shellfish Information Leaflet 27., Ministry of Agriculture Fisheries and Food

Round, F. E., J. F. Sloane, F. J. Ebling and J. A. Kitching (1961). "The ecology of Loungh Ine. X. The hydroid Sertularia operculata (L.) and its associated flora and fauna: effects of transference to sheltered water." J. Ecology **49**: 617-629.

Rudders, D. B., W. D. Du Paul, J. D. Lange Jr and K. D. Goff (2001). Survey methodology for the evaluation of the sea scallop *Placopecten magellanicus* population in the mid atlantic closed areas. ICES Working Group on Fising Technology and Fish behaviour, Seattle, USA, ICES.

Rumohr, H., S. Ehrich, R. Knust, T. Kujawski, C. J. M. Philippart and A. Schroeder (1998). Long-term trends in demersal fish and benthic invertebrates. The effects of different types of fisheries on the North Sea and Irish Sea benthic ecosystems NIOZ-Rapport 1998-1/Rivo-Dlo Report C003/98,. E. b. H. J. L. a. S. J. d. Groot**:** 280-352 .

Rumohr, H. and P. Krost (1991). "Experimental evidence of damage to benthos by bottom trawling with special reference to *Arctica islandica*." MEERESFORSCHUNG-REP.-MAR. RES **33**(4): 340-345.

Russo, A. and P. E. Artegiani (1996). "Adriatic Sea hydrography." Scientia Marina **60** (2): 33-43.

Sainsbury, K. J. (1988). The ecological basis of multispecies fisheries management of a demersal fishery in tropic Australia. In Fish Population Dynamics. e. (J.A. Gulland. Chichester., John wiley**:** pp.349-82.

Sanches, J. G. (1989). "Nomenculatura Portuguesa de Organismos aquáticos." Publicações avulsas do INIP, Lisboa **14**: 322p.

Sangster, G. I. (1994). A review of the survival of fish escaping from fishing gears. Report of the sub group on methodology of fish survival experiments: ICES 1994/B:8.

Santarèm, M. M., J. A. F. Robledo and A. Figueras (1994). "Seasonal changes in hemocytes and serum defence factors in the blue mussel *Mytilus galloprovincialis*." Dis Aquat Org **18**: 217-222.

SAS Institute Inc (1989). "SAS/STATS® User's guide, Version 6, Fourth Edition." **2**.

Scardi, M., P. Di Dato, R. Crema, E. Fresi and G. Orel. (1997). Analisi preliminare dei dati sulle comunità macrozoobentoniche dell'Alto Adriatico: dagli anni '30 ai giorni nostri. Workshop PRISMA2, Bologna.

Scherrer, B. (1984). "Biostatistique." *Gaëtan Morin. Canada-Québec*: 850p.

Searle, S. R., G. Cassella and M. C.E. (1992). Varaince Components. New York, Wiley.

Serchuk, F. M. and R. J. Smolowitz (1980). Size selection of sea scallops by an offshore scallop survey dredge, ICES C.M.1980/K:24

Sharp, J. H. (1974). " Improved analysis for "particulate" organic carbonate-containing solids." Limnol. Oceanogr **19**: 984-989.

Sheader, M. (1986). "The effects of intensive dredging on benthic community structure." Nature Conservancy Council.

Sheldon, R. W., A. Prakash and W. H. Sutcliffe (1972). "The size distribution of particles in the ocean." Limnol. Oceanogr **17**: 327-340.

Shepard, A. N. and P. J. Auster (1991). Incidental (non-capture) damage to scallops caused by dragging on rock and sand substrates. An international compendium of scallop biology and culture. S. E. Shumway and P. A. Sandifer. Baton Rouge, World Aquaculture Society**:** 219-230.

A rock rake or drag is used inshore off the coast of Maine to commerciallt harvest sea scallops, *Placopecten magellanicus* (Gmelin). The gear is designed for use in rocky habitat. In Swans Island conservation Area, recently closed to commercial dragging, scallop habitat is extremely variable with respect to substrate type. Tests tows showed the drag fished differently in response to catch weight, tow direction, and less than 25% changes in tow speed and scope of the warp. Incidental damage was significantly higher on rock than sand substrate; 25.5% vs 7.7% in 1988 experiments. The dominant types of damage were chipped shell margins and separated hinges. The severity of damage may be related to catch weight and number of tows impacting an individual. No relationship was observed between scallop shell size and incidental damage rate.

Siegel, S. (1988). Nonparametric statistics for the behavioural sciences. New York, McGraw-Hill.

Skjoldal, H. R. (1981). "ATP concentration and Adenylate Energy Charge of tropical zooplankton from waters inside the Great Barrier Reef " Mar. Biol., **62** 119-123.

Skjoldal, H. R. and T. Bakke (1978). "Relationship between ATP and energy charge during lethal metabolic stress of the marine isopod *Cirolana borealis*." J. of Biol. Chem **253**: 3355-3356.

Skoeld, M. and R. Rosenberg (1996). "Arm regeneration frequency in eight species of Ophiuroidea (Echinodermata) from European Sea Areas." Journal of Sea Research **35**: 353-362.

Slater, J. (1995). Scallop spat collection in Mulroy Bay, Ireland, 1979-1994. 10th International Pectinid Workshop, Cork, Ireland.

Slomp, C. P., Malschaert, J. F. P.,Van Raaphorst, W. (1998). "The role of absorption in

sediment-water exchange of phophate in North Sea continental margin sediments." Limnol. Oceanogr **43**(5): 832-846.

Smaal, A. C. and J. Widdows (1994). The scope for growth of bivalves as an integrated response parameter in biological monitoring. . Biomonitoring of coastal waters and estuaries. . K. J. M. Kramer and CRC Press. Boca Raton, Florida 247-267.

Smith, C. R. (1985). "Food for the deep sea: utilization, dispersion, and flux of nekton falls at the Santa Catalina Basin floor." Deep Sea Res **32**: 417-442.

Smith, E. M., Howell, P.T. (1987). "The effects of bottom trawling on Amarican lobsters. *Homarus americanus*, in Long Island Sound." Fish Bull **85**: 737-744.

Smith, G. (1982). Elements of Soil Mechanics for Civil and Mining Engineers. Granada.

Smolowitz, R. J. (1998). Bottom tending gear used in New England. Effect of Fishing Gear on the Sea Floor of New England., Boston, Massachusetts, Conservation Law Foundation.

Summary: This paper is a brief review of five major gear types used in New England that contact the sea floor during their operation: bottom trawls, scallop dredges, gill nets, hooks, and lobster traps. Each gear type is outlined in terms of technical evolution, bycatch, selectivity, and management issues. The review emphasizes how the gear interacts with bottom habitat and the possible impacts of this interaction. The paper concludes that cumulative fishing impacts of each gear type need to be identified in order to define appropriate fishing levels/strategies.

Smolowitz, R. J. and F. M. Serchuk (1989). Developments in sea scallop gear design. Proceedings of the World Symposium on Fishing Gear and Fishing Vessel Design, St. Johns, Newfoundland, Canada, 1988.

Sobral, M., Jorge, I., 1989. (1989). "Prospecção de Amêijoa Branca (*Spisula solida* L.) no litoral Norte da costa portuguesa nos meses de Maio/Junho e Outubro de 1986." Relatórios Técnicos e Científicos do INIP, Lisboa **nº17**: 15p.

Socal, G., P. Franco and P. Franco (1995). L'Adriatico settentrionale. Regione del Veneto. Piano per il rilevamento delle caratteristiche qualitative e quantitative dei corpi idrici della Regione Veneto. **III:** 7-12.

Soemodihardjo, S. (1974). Aspects of the biology of *Chlamys opercularis* (L.) (Bivalvia) with comparative notes on four allied species, University of Liverpool.

Sokal, R. R. and F. J. Rolhf (1981). Biometry. New York, W.H. Freeman & Company.

Sokolowski, A., M. Wolowicz, H. Hummel and R. Bogaards (1999). "Physiological responses of *Macoma balthica* to copper pollution in the Baltic." Oceanol. Acta. **22**: 431-439.

Spoor, G. and R. J. Godwin (1978). "An experimental investigation into loosening soil by rigid tines." Journal of Agricultural Engineering Research **23**: 243-257.

Sprung, M. (1993). "Estimating macrobenthic secondary production from body weight

and biomass: a field test in a non-boreal intertidal habitat." Marine Ecology Progress Series **100**: 103-109.

Sprung, M. (1994). "Macrobenthic secondary production in the intertidal zone of the Ria Formosa-a lagoon in southern Portugal." Estuarine Coastal and Shelf Science, **38**: 539-558.

Sprung, M. (1994). "High larval abundance in the Ria Formosa-a lagoon in southern Portugal-methodological or local effects?" Journal of Plankton Research **16**: 151-160.

Stefanon, A. (1984). " Sedimentologica del mare Adriatico: rapporti tra erosione e sedimentazione olocenica." Boll. Oceanol. Teor. Appl. **II**(4): :281-321.

Stefanon, A. (1985). " Marine sedimentology through modern acoustical methods: I. Side Scan Sonar." Boll. Oceanol. Teor. Appl. **III**(1): 3-38.

Steingrimsson, S. A. (1989). A comparative ecological study of two *Glycymeris glycymeris* (L.) populations off the Isle of Man., Liverpool**:** 121.

Stella, P. and E. Rodinò (1986). "Ricerche sulla variabilità genetica del bivalve Chamelea (Venus) gallina (L.)." Atti Ist. Veneto Sci. **144**: 49-62.

Stephens, P. J. and P. R. Boyle (1978). "Escape responses of the queen scallop *Chlamys opercularis* (L.) (Mollusca: Bivalvia)." Marine Behaviour and Physiology **5**: 103-113.

Stephenson, R. R. and D. Taylor (1975). " The influence of EDTA on the mortality and burrowing activity of the clam (*Venerupis decussata*) exposed to sub lethal concentrations of copper." Bull. Envir. Contam. Toxicol. **14**: 304-308.

Stevens, P. M. (1987). "Response of excised gill tissue from the New Zealand scallop Pecten novaezelandiae to suspended silt." Nz J Mar Freshwat Res **21**: 605-614.

Sundby, B., Gobeil, C., Siverberg, N., Mucci, A. (1992). "The phosphorus cycle in coastal marine sediments." Linmol. Oceanogr **37**: 1129-1145.

Suresh, K. and A. Mohandas (1990). "Effect of sublethal concentrations of copper on haemocyte number in bivalves." J. Invertebr. Pathol. **55,**: 325-331.

Tamsett, D., G. Janacek, M. Emberton, B. Lart and G. Course (1999). "Onboard sampling for measuring discards in commercial fishing based on multilevel modelling of measurements in the Irish Sea from NW England and N Wales." Fisheries Research **42**: 117-126.

Tang, S. F. (1941). "The breeding of the scallop (*Pecten maximus* (L.)) with a note on growth rate." Proceeding and Transactions of the Liverpool Biological Society **54**: 9-28.

Tebble, N., 1966. (1966). British bivalve seashells. A handbook for identification. Edinburgh:, *British Museum*.

Teixeira, S. B. (2000). Lithology of beach gravel in central Algarve (Portugal).

Proceeding of the 3º Symposium on the Iberian Atlantic Continental Margin,, Faro, Ciacomar, Universidade do Algarve.

Tétard, A., Boon, M. et al. (1995). Catalogue international des activités des flotilles de la Manche. Brest, IFREMER**:** p. 154, 162.

Thomas, D. (1993). "Marine wildlife and net fisheries in carding Bay." RSPB/CCW report.

Thomas, G. E. and L. D. Gruffydd (1971). "The types of escape reactions elicited in the scallop *Pecten maximus* by selected sea star species." Marine Biology **10**: 87-93.

Thompson, R. J., D. R. Livingstone and d. Z. A (1980). "Physiological and biochemical aspects of valve snap and valve closure responses in the giant scallop Placopecten magellanicus. I. Physiology." J. Comp. Physiol. **137**: 97-104.

Thrush, S. F., J. E. Hewitt, V. J. Cummings and P. K. Dayton (1995). "The impact of habitat disturbance by scallop dredging on marine benthic communities: What can be predicted from the results of experiments?" Mar. Ecol. Prog. Ser **129**: 141-150.

Toorman, E. (1996). "Sedimentation and self-weight consolidation: general unifying theory." Géotechnique **46**: 103-113.

Tuck, I., B. Ball and A. Schroeder (1998). Comparison of undisturbed and disturbed areas. In The effects of different types of fisheries on the North Sea and Irish Sea benthic ecosystems,. L. H. J and S. J. de Groot, Nioz-Rapport 1998-1/Rivo-Dlo Report C003/98,**:** pp 245-280.

Tuck, I. D., N. Bailey, M. Harding, G. Sangster, T. Howell, N. Graham and M. Breen (2000). "The impact of water jet dredging for razor clams, *Ensis spp*. In a shallow sandy subtidal environment." J. Sea Res **43**: 65-81.

Tyurin, A. N. (1991.). "Behavioural reactions of the scallop, *Mizuhopecten yessoensis*, and the mussel, Crenomytilus grayanus, to reduced salinity and oxygen and exposure to synthetic detergents." J. of Hydro Biol. **24**(4): 13-19.

Vaccarella, R., G. Marano and A. M. Pastorelli (1988). "Valutazione dello stocks di vongole nel basso Adriatico." Atti dei Seminari delle unità operative responsabili dei progetti di ricerca promossi nell'ambito dello schema preliminare di piano per la pesca e l'acquacoltura **1**: 403-420.

Vaccarella, R. and P. Paparella (1998). "Mappatura dei banchi di *Chamelea gallina* (L.) nei compartimenti marittimi di Termoli, Manfredonia e Molfetta (Adriatico Meridionale): 1994-1995." Biologia Marina Mediterranea **5**(1): 646-650.

Vaccarella, R., A. M. Pastorelli and G. Marano (1998). "Studio sulla efficienza delle draghe turbosoffianti e loro effetti sulle comunità bentoniche." Biologia Marina Mediterranea **5**(3): 676-683.

Vaccarella, R., A. M. Pastorelli, P. Paparella, V. De Zio, L. Rositani and M. G. (1998).

"Fluttuazioni di biomassa di *Chamelea gallina* (Bivalvia: Veneridae) nel Basso Adriatico (1984-1995)." Biologia Marina Mediterranea **5**(2): 420-432.

Valli, G., Zardini D. and Nodari P. (1985). "Cycle reproductif et biométrie chez *Chamelea gallina* (L.) (Mollusca Bivalvia) dans le Golfe de Trieste. Rapp." Comm. Mer Medit. **29**(5): 339-340.

Van Beek, F., P. Van Leeuwen and A. Rijnsdorp (1990). "On the survival of plaice and sole discards in the otter trawl fisheries in the north Sea." Netherland Journal of Sea Research **26**: 151-160.

van Dolah, R. F., P. H. Wendt and N. Nicholson (1987). "Effects of a research trawl on a hard-bottom assemblage of sponges and corals." FISH.-RES. **5**(1): 39-54.

van-Dolah, R. F., M. Y. Bobo, M. V. Levisen, P. H. Wendt and J. J. Manzi (1991). "Effects of marina proximity on the physiology condition, reproduction, and settlement of oyster populations." J. SHELLFISH RES. **11**: 41-48.

Vatova, A. (1940). "Le zoocenosi della Laguna Veneta." Nova Thalassia **3**: 1-28.

Vatova, A. (1948). "Ricerche sulla fauna bentonica e loro importanza per la pesca." Ricerca Scientifica **18**: 975-980.

Vatova, A. (1949). "La fauna bentonica dell'alto e medio Adriatico." Nova Thalassia **1**: 1-110.

Vatova, A. (1949). "La fauna bentonica dell'alto e medio Adriatico " Nova Thalassia, **1** 1-110.

Vatova, A. (1966). "La fauna bentonica della costa occidentale dell'alto Adriatico." Arch. Ocean. Limnol. (Suppl.) **15**: 159-167.

Vatova, A. (1966). "La fauna bentonica della costa occidentale dell'alto Adriatico " Arch. Ocean. Limnol. **15 Suppl**: 159-167.

Veale, L. O., A. S. Hill and A. R. Brand (2000). "An in situ study of predator aggregations on scallop (*Pecten maximus* (L.)) dredge discards using a static time-lapse camera system." Journal of Experimental Marine Biology and Ecology **255**(1): 111-129.

The impact of demersal fishing gears on benthic habitats and species has been the subject of much attention recently, and suggestions have been made that scavenging epifaunal species may benefit at the population level from the additional food source provided by discards. This paper investigates some aspects of this process, including the relative attractiveness to predators of different discard species, and the role of damage in scavenger attraction. A time-lapse video system with a 1000 m long cable was positioned in an area closed to fishing, adjacent to the most heavily fished scallop (Pecten maximus) ground in the Irish Sea. A variety of undamaged and damaged by-catch animals were positioned in front of the camera, and the subsequent predator aggregations investigated. Densities of scavenger species up to 200 times that

of the background population were observed, and aggregations of some species persisted for up to 3 days. The most frequently recorded scavengers, and therefore presumably those species most likely to benefit from discards as a food source, were: Asterias rubens L., Astropecten irregularis (Pennant), Liocarcinus spp Stimpson, Pagurus spp Fabricius and Callionymus lyra L. Predator attraction to apparently undamaged queen scallops, Aequipecten opercularis (L.), was almost as high as to damaged A. opercularis. Of all the prey species studied, queen scallops were the most attractive to scavengers. A directional relationship was found between the ambient water current and the arrival of the starfish, Asterias rubens.

Veale, L. O., A. S. Hill, S. J. Hawkins and A. R. Brand (2000). "Effects of long-term physical disturbance by commercial scallop fishing on subtidal sedimentary habitats and epifaunal assemblages." Marine Biology **137**(2): 325-337.

This paper examines spatial differences in the distribution of by-catch assemblages from the scallop [*Pecten maximus* (L.) and *Aequipecten opercularis* (L.)] fishing grounds in the North Irish Sea, during 1995. The sites examined have been exposed to differing known levels of fishing disturbance by scallop dredging, based on unusually high-resolution data extracted from fishermens' logbooks. Uni- and multi-variate techniques have been used on a production dataset (a value which incorporates both abundance and biomass figures), as well as abundance and biomass data individually. The original species list was reduced to higher taxonomic groupings in line with the theory that the latter is more appropriate for detecting anthropogenic change. Species diversity and richness, total number of species, and total number of individuals all decrease significantly with increasing fishing effort. Species dominance increases with effort. Total abundance, biomass and production, and the production of most of the major individual taxa investigated decrease significantly with increasing effort. Multivariate analysis reveals a significant relationship between fishing effort and by-catch assemblage structure. The taxa most responsible for the differences are the echinoids and cnidarians, but prosobranch molluscs and crustaceans also contribute to the differences. By-catch assemblage structure is more closely related to fishing effort than any other environmental parameter investigated, including depth and sediment type. We observed an approximately linear decrease in diversity with increasing fishing disturbance, and suggest this is primarily due to selective removal of sensitive species and, more importantly, habitat homogenisation. These results were interpreted in the light of ecological theories relating disturbance to community structure. The argument that invertebrate scavenger populations benefit from prolonged exposure to fishing disturbance was also examined, but no supporting evidence was found.

Veale, L. O., A. S. Hill, S. J. Hawkins and A. R. Brand (2001). "Distribution and damage to the by-catch assemblages of the northern Irish Sea scallop dredge fisheries." J Mar Biol Ass UK **81**: 85-96.

Veer, H. W. v.-d., M. J. N. Bergman and J. J. Beukema (1985). "Dredging activities in the Dutch Wadden Sea: Effects on macrobenthic infauna." NETH. J. SEA RES. **19**(2): 183-190.

Veldhuizen-Tsoerkan, M. B., D. A. Holwerda and D. I. Zandee (1991). "Anoxic survival

time and metabolic parameters as stress indices in sea mussels exposed to cadmium or polychlorinated biphenyls." Arch. Environ, Contam. Toxicol. **20**: 259-265.

Veniza, A. F. (1988). "Sampling variance and the design of quantitative surveys of the marine benthos." Marine Biology **97**: 151-155.

Verschraegen, K., P. M. J. Herman, D. Van Gansbeke and A. Braeckman (1985.). "Measurement of the adenylate energy charge in *Nereis diversicolor* and *Nephtys* sp. (Polychaeta: Annelida): Evaluation of the usefulness of AEC in pollution monitoring." Mar. Biol. **86**: 233-240.

Viarengo, A., L. Canesi, M. Pertica and D. R. Livingstone (1991). "Seasonal variations in anti-oxidant defense systems and lipid peroxidation of the digestive gland of mussels." Comp. Biochem. Physiol. **100C**: 187-190.

Vieira, N., M. Mateus and H. Coelho (2000). Temperature, salinity and geostrophic distributions in the Iberian Atlantic Margin. Proceeding of the 3º Symposium on the Iberian Atlantic Continental Margin, Faro, Ciacomar, Universidade do Algarve.

Vincent, C., R. Young and D. Swift (1981). "Bedload transport under waves and currents." Marine Geol., **39**: 71-80.

Volvenko, I. V. (1994). "Consumers and the defensive behavior of hermit crabs." RUSS. J. MAR. BIOL.;BIOL. MORYA **21**(1): 1-7.

Wachstein, M. and E. Meisel (1957). "Histochemistry of hepatic phosphatases at a physiological pH with special reference to the demonstration of bile canaliculi " Am J Clin Pathol **27** 12-23.

Walne, P. R. and R. Mann (1975). Growth and biochemical composition in *Ostrea edulis* and *Crassostrea gigas*. Proceeding of the Ninth European Marine Biology Symposium. H. Barnes. Aberdeen, Scotland, Aberdeen University Press,**:** 587-607.

Wanninayake, T. (1994). Seasonal cycles of two species of scallop (Bivalvia: Pectinidae) on an inshore and an offshore fishing ground, University of Liverpool**:** 154pp.

Warnock, F. V. and P. P. Benham (1965). Mechanics of Solids and Strength of Materials. London, Pitman Paperbacks.

Wassenberg, T. J. and B. J. Hill (1987). "Feeding by the sand crab *Portunus pelagicus* on material discarded from prawn trawlers in Moreton Bay, Australia." Mar. Biol **95**: 387-393.

Watling, L. and A. Norse (1998). "Disturbance of the seabed by mobile fishing gear: a comparison with forest clear-cutting." Cons. Biology **12**(6): 1180-1197.

Wedemeyer, G. A., D. J. McLeay and C. P. Goodyear (1984). Assessing tolerance of fish populations to environmental stress: the problems and methods of monitoring. Contaminant effects of fisheries. V. W. Cairns, P. V. Hodson and J. O. Nriagu. Toronto,

Canada., John Wiley and Sons**:** 163-195.

Wei, J., L. M. Shaw and A. M. Mercurio (1997). "Integrin signaling in leukocytes: lessons from the α6β1 integrin." J. Leukocyte Biol. **61**: 397-407.

Widdows, J. (1978). "Combined effects of body size, food concentration, and season on the physiology of *Mytilus edulis*." J. Mar. Biol. Ass. U.K. **58**: 109-124.

Widdows, J. (1978). "Physiological indices of stress in *Mytilus edulis*." J. Mar. Biol. Ass. U.K **58**.

Widdows, J. (1985). Physiological measurements. . The effects of stress and pollution on marine animals. . B. B. L. e. al. New York, Praeger Press**:** 3-45.

Wiebe, W. J. and K. Bancroft (1975). "Use of the adenylate energy charge ratio to measure growth state of natural microbial communities " Proc. Natn. Acad. Sci. U.S.A., **72** 2112-2215.

Wijsman, T. (1976). "Adenosine Phosphates and Energy Charge in different tissues of *Mytilus edulis* L. under aerobic and anaerobic conditions." J. Com. Phys. **107**: 129-140.

Wijsman, T. C. M. (1976). "ATP content and mortality in *Mytilus edulis* from different habitats in relation to anaerobiosis." Neth. J. of Sea Res. **10**: 140-148.

Wilson, J. H. (1987). "Spawning of *Pecten maximus* (Pectinidae) and the artificial collection of juveniles in two bays in the west of Ireland." Aquaculture **61**: 99-111.

Wilson, R. R. J. and K. L. J. Smith (1984). "Effects on near-bottom currents on detection of bait by the abyssal grenadier fishes *Coryphaenoides* spp., recorded in situ with a video camera on a free vehicle." Mar. Biol **84**: 83-91.

Wilson, U. A. W. (1994). The potential for cultivation and restocking of *Pecten maximus* (L.) and *Aequipecten (Chlamys) opercularis* (L.) on Manx inshore fishing grounds, University of Liverpool.

Worms, J. and M. Lanteigne (1986). "The selectivity of a sea scallop (*Placopecten magellanicus*) Digby dredge." ICES C.M. 1986/K:23: 26 pp.

Yalin, M. (1977). Mechanics of Sediment Transport. Oxford, Pergamom Press.

Yoshino, T. P. and T. C. Cheng (1976). "Fine structural localization of acid phosphatase in granulocytes of the pelecypod *Mercenaria mercenaria*." Transactions of the American Microscopy Society **95**: 215-220.

Zander, C. D. (1982). "Relationships between morphology and way of life in Blenniidae (Pisces) from the Red Sea. II. Anatomy of the fins and their musculature.
OT: Beziehungen zwischen Korperbau und Lebensweise bei Blenniidae (Pisces) des Roten Meeres. II. Bau der Flossen und ihrer Muskulatru." Z Morphol Tiere **71**(4): 299-327.

Zar, J. H. (1996). Biostatistical analysis., Prentice-Hall, Inc.

Zaroogian, G. E., J. H. Gentille, J. F. Heltshe, M. Johnson and A. M. Ivanovici (1982.). "Application of adenine nucleotide measurements for the evaluation of stress in *Mytilus edulis* and *Crassostrea virginica*." Comp. Biochem. Physiol. **71B**: 643-649.

Zimmer-Faust, R. K., Case, J.F. (1983). "A proposed dual role of odor in the foraging by the California spiny lobster, Panulirus interruptus (Randall)." Biol. Bull. Mar. biol. Lab., Woods Hole **164**: 341-353.

Zimmer-Faust, R. K. (1993). "ATP: A potent prey attractant evoking carnivory." Limnology and Oceanography **38**: 1271-1275.
predators attracted to ATP released from damaged tissue

Zobell, C. E. (1946). "Studies on redox potential of marine sediment." Bull. Am. Ass. Petr.Geol. **30**(4): 477-512.

Zwaan, A. d. (1977). "Anaerobic energy metabolism in bivalve molluscs." Oceanogr. Mar. Biol. Ann. Rev. **15**: 103-187.