

CURRICULUM VITAE

• Personal Details

Name: Prof. Muki Shpigel

P.O.B: Haifa, Israel

Work: Morris Kahn Marine Research Station, Department of Marine Biology, Leon H. Charney School of Marine Sciences, University of Haifa.

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• Education

B. Sc. 1972-1974 at Tel Aviv University in Biology.

M. Sc. 1974-1978 (with honors, Tel Aviv University) in Marine Biology.

Title of thesis: "The spatial heterogeneity in branching corals and fish species diversity"

Advisor: Prof. Yossi Loya.

Ph. D. 1978-1985, Tel Aviv University in Marine Biology.

Title of thesis: "Aspects of the biology and ecology of the Red Sea groupers *Cephalopholis* (Serranidae, Teleostei)".

Advisor: Prof. Lev Fishelson

1989-1990: Postdoctoral position at the Virginia Institute of Marine Science (VIMS) in Prof. Roger Mann's department. Research subject: bivalve bioenergetics.

• Positions Held and Academic Status:

2018-todate: Senior Research Scientist. Morris Kahn Marine Research Station, Department of Marine Biology, Leon H. Charney School of Marine Sciences, University of Haifa.

2017-2018: Visiting scientist at the "Interuniversity Institute for Marine Sciences"

2010-to date: Adjunct Professor "Ben Gurion University of the Negev".

1985-2017 (RETIRED): Senior Research Scientist at the Israel Oceanographic and Limnological Research, National Center for Mariculture (Grade A+).

1998-1999: Sabbatical leaves, at N.O.A.A, Milford Laboratory, Milford, CT, USA.

• Employment History

1985 -2017: Head of the Department of Integrated Multi-Trophic Aquaculture (IMTA) Systems.

1982-1985: Research assistant, Department of Zoology, Tel Aviv University (for Profs. L. Fishelson and Y. Loya).

1982-1985: Chief Scientist in environmental impact surveys carried out for the Municipality of Herzlia, Israel (1982-1983).

1984-1985: Preliminary impact survey for the municipality of Haifa.

1985: Aquaculture-recreation impact survey for a private company in Nigeria

1975-1982: Field Study Center, Naama, Sinai. The Society for the Protection of

Nature in Israel. Responsible for nature protection in the Gulf of Eilat.
Head of educational program of the Field Study Center.
1973-1974: Assistant curator, Zoological Museum, Tel Aviv University.

- **Professional Activities**

(a) Professional and Academic administration functions:

- 2017: Member of grants evaluation committee for the “ministry of sciences”.
- 2012-2017: Expert Panel of the EU commission.
- 2015: Member of grants evaluation committee for the “ministry of agriculture”.
- 2015: Member of grants evaluation committee for the ERA-Net COFASP “French National Research Agency”
- 1999-2009: Member of the honors and awards committee, the World Aquaculture Society.
- 2006: Session organizer of the polyculture session for the World Aquaculture conference in Florence, Italy in May 2006.
- 2005: Committee member in EFARO (European Fisheries Aquaculture organization) on future of aquaculture in Europe.
- 2003: Steering committee member in the Sea Urchin Conference in Chile 2003.
- 2002: Session organizer of the polyculture session for the World Aquaculture Society conference in Beijing, China.
- 2001: Organizer and moderator of polyculture session for the World Aquaculture Society conference in Orlando, Florida, USA.
- 1985-1988: Advisor to the Ministry of Environment of Israel on various issues concerning nature protection such as the impact of yacht marinas and sedimentation on coral reef ecosystems and the impact of sewage on the coral reefs.
- 1985-2000: Advisor to the "Nature Reserves Authority" on various issues concerning nature protection of coral reefs such as the impacts of divers and underwater vessels on the coral reef ecosystem and the impacts of commercial rearing of local reef fish on the coral reef.
- 1993-1999: As member of the Israeli Diving Federation directorate, initiated and established a foundation for M.Sc. students for research on the marine environment.
- 1993-1998: Advisor to the Israel Union for Environmental Defense on various issues concerning nature protection.
- 1998: Invited by Fremantle University of Tafe, West Australia as a consultant to set up an experimental IMTA system.
- 1998: Invited to Big Island Abalone Farm in Kailu-Kona, Hawaii as a consultant to set up abalone-seaweed integrated system.
- 1992-2000: Board of Directors, Israeli Underwater Federation (22,000 members).
Head of the Environmental Protection Committee.
- 1998: Organizer of the Integrated Systems Session for the World Aquaculture Society conference in Sydney, 1999.
- 1993-1995: Steering Committee and preparation of the curriculum course on mariculture for the Maritime and Mariculture College “Mevuoth Yam” Michmoret
- 1992: Organizer of a meeting on Sea Protection with the Institute for Nature Conservation Research of Tel-Aviv University and the Israeli Underwater Federation on sea protection. Tel-Aviv University. September 23, 1992.

1976-1982: Chief Scientist in marine and terrestrial surveys in the Sinai Peninsula, for the Society for the Protection of Nature in Israel.

(b) Editor or member of editorial board of scientific/professional journal:

1999- 2016- Associate Editor "Journal of the World Aquaculture Society"

2007- 2014- Associate Editor "Journal of Applied Aquaculture"

2012- 2014- Associate Editor "journal Aquatic Biosystems"

1988-1995- Editorial board "YAM" (diving magazine). Editor of a special issue (1994) devoted to the protection of the sea

(c) Reviewer of manuscripts for the following journals:

1. Aquaculture.
2. Aquacultural Engineering.
3. Aquaculture International.
4. Aquaculture research.
5. Bamidgeh.
6. Journal of Experimental Marine Biology and Ecology.
7. Journal of Shellfish Research.
8. Marine Biology.
9. Marine Ecology.
10. Environmental Technology.
11. Journal of applied phycology

(c.1) Reviewer of grant proposals submitted to:

1. The German Israeli Foundation for Scientific Research and Development (GIF).
2. The Israel Inter-University (IUI) Ecology Fund
3. Binational Agriculture Research and Development Fund (BARD, Israel-US)
4. The Israel Science Foundation (ISF).
5. SBIR-Small business innovation research, Department of Commerce - USA
6. The Israel Academy of Science and Humanities.
7. Ministry of Agriculture, South Africa (NRF).
8. Ministry of Agriculture, Israel.
9. EU commission (expert panel-2011-2015)
- 10 GIF, German Israel foundation

(d) Membership in professional/scientific societies:

1987 – Today World Aquaculture Society

1990 – Today European Aquaculture Society.

1987 – 2016 National Shellfisheries Association, USA

2004 – 2014 Israel Society of Aquaculture

1985 – 1995 Israel Society of Zoology

Educational activities

Courses taught

a. National

2017-2019: Lecturer at the Maritime College of Mikhmoret on: 1. Introduction to Mariculture.

- 2009- 2017: Ben Gurion University, “Fish Biology, Ecology and Biotechnology”.
- 1995- 2013: The Faculty of Agriculture, Hebrew University of Jerusalem.
Coordinator of the course “Introduction to Mariculture” and lecturer on “Molluscs in Mariculture” and on “Marine Polyculture and Integrated Systems”.
- 2000–2003: A guest lecturer at the Heinz Steinitz Interuniversity Institute, Eilat in the course “The Ecology System of the Gulf of Eilat” (Coordinators - Drs. A. Ganin and Micha Ilan).
Lecture on “The Effects of Mariculture on the Gulf of Elat”, “Predator-Prey Interactions and Sex Reversal in the Coral Reef Ecosystem” and "Environmentally Friendly Aquaculture in the Gulf of Elat".
- 1998-2000: Lecturer at the Maritime College of Mikhmoret on: 1. Fish behavior. 2. Introduction to Mariculture
- 1994–2000: The Faculty of Agricultural Engineering, the Technion, Haifa: Coordinator of the course “Introduction to Mariculture” and lecturer on “Bivalves as a Biofilter” and “Marine Polyculture”.
- 1986-1993: Faculty of Agriculture, Hebrew University of Jerusalem.
Lecturer on: “Bivalve Culture and Reproduction” (Part of the course “Introduction to Mariculture”, coordinator - H. Gordin)
- 1982-1985: Teaching assistant in the following courses given at the Department of Zoology, Tel Aviv University:
Invertebrate Zoology- Prof. Y. Loya
Marine Ecology - Prof. L. Fishelson
Life in the Intertidal Zone of the Mediterranean - Dr. M. Goren

b. International

- 2013: Visiting Professor in Cagliari University, Sardinia, Italy. Coordinator of the course “Introduction to Mariculture”
- 2005: China-Israel workshop on Aquaculture, Qindao, P.R. China
- 2005-2011 Lecturer in the international post graduate course on aquaculture organised by the Faculty of Agriculture, Hebrew University of Jerusalem.
- 2003: Invited as lecturer in international advanced seminar on mollusk production in Mediterranean countries by CIHEAM, Zaragoza, Spain.
- 2002: Invited as lecturer by CIHEAM to international training course on “recirculation systems for fish culture” in Sete, France in January 2004.
- 2000: Invited as lecturer in advanced training course of Sea Urchin Aquaculture and integrated systems, at the International Marine Center, Torregrande, and Sardinia, Italy.
- 1988-1990: Guest lecturer at the University of Maryland, Dept. of Zoology: “Space Partitioning and Symbiosis in Coral Reef Fish” (part of the course “Life in the Ocean”, coordinator - Prof. Eugenie Clark).

a. Research students

- 1988-1990: Miron Sarid, M.Sc. student, the Faculty of Agriculture, The Hebrew University of Jerusalem. Thesis title: "The influence of water temperature, algae concentration and water flow on the filtration rates of *Crassostrea gigas*". Guidance with Prof. Balfur Heffer.

- 1991-1992: Micha Vaisbaum, graduate student, a final project for the degree of engineer.
The Faculty of Agricultural Engineering, The Technion, Haifa.
Thesis title: "Grading machine for edible oysters". Guidance with Prof. Eitan Kimmel).
- 1992-1994: Alon Ben-Gal, M.Sc. student, Department of Environmental Sciences, The Hebrew University of Jerusalem.
Thesis title: "Bioaccumulation of halogenated phenols from chlorinated seawater in bivalve molluscs". Guidance with Prof. H. Shoval.
- 1993-1994: Dana Zelding, final project for the degree of practical engineer.
The Braude Bioengineering College, Carmiel.
Thesis title: "Using edible oysters and clams as a biofilter of fishpond effluents".
- 1993-1994: Gal Hauzer, final project for the degree of practical engineer.
The Braude Biotechnology College, Carmiel.
Thesis title: "Bioenergetics of the European abalone, *Haliotis tuberculata*."
- 1993-1994: Shaul Golomb, graduate student, final project for the degree of engineer.
The Faculty of Agricultural Engineering. The Technion, Haifa.
Thesis title: "Commercial methods for collecting burrowing clams from the sediment". Guidance with Prof. Eitan Kimmel.
- 1998: Nurit Gordon, M.Sc. student, Faculty of Agriculture, The Hebrew University of Jerusalem. Thesis title: "Nutritional requirements of metamorphosed abalone (*Haliotis discus hannai*)". Guidance with Drs. S. Harpaz and A. Neori. Guidance with Dr. Amir Neori and Prof. Jaap Van Rijn. The Faculty of Agriculture.
- 2001-2002: Andreas Schuenhoff, M.Sc. student, University of Las Palmas de Gran Canaria, Portugal. Thesis title: "The Performance of a Semi-Commercial, Integrated System for the Culture of Fish and Seaweed."
- 2003-2006: Eran Hadas, Ph.D. student, Tel Aviv University. Thesis title: "Energy budget on the demosponge *Negombata magnifica*." Guidance with Dr. Micha Ilan. Tel Aviv University. (with honors).
- 2004-2007: Hyar Katz, M.Sc. student, Faculty of Agriculture, The Hebrew University of Jerusalem. Thesis title: "Nitrogen budget in fish, bivalves, seaweed integrated system". Guidance with Prof. Jaap Van Rijn. The Faculty of Agriculture.
- 2010-2014: Hanit Ben Ari: Ph.D. student, BGU University. Thesis title: Control the gametogenesis of the purple sea urchins *Paracentrotus lividus*. Guidance with Dr., Hanna Rosenfeld (with honors).
- 2010-2014: Tomer Ben Ari: M.Sc. student, BGU University. Thesis title: Nutrient and energy budget in Multi-trophic integrated mariculture system (with honors).
- 2011-2015: Erez Yeruham: M.Sc. Student, Tel Aviv University. Thesis title: Ecology of the sea urchins *Paracentrotus lividus* in the Eastern Mediterranean coast. Guidance with Prof. Abelson Avigdor.
- 2016-2017: Dr. Suzanne Buxbaum. A Post-Doc position.
- 2016-2018: Matan Yona: M.Sc. Student. Department of Environmental Sciences. The Hebrew University of Jerusalem. Thesis title: biomineralization processes in sea urchins using fluorescent dyes and confocal microscopy. Guidance with Prof. Jonathan Erez.

2019: Itay Kalski. M.Sc. Student. Morris Kahn Marine Research Station, Department of Marine Biology. Leon Charney School of Marine Sciences, University of Haifa. Guidance with Prof. Tali Mass..

Scientific Publications

(a) Authored books

1. **Shpigel, M.** (1994). Red Sea Fish. The Society for the Protection of Nature Pub. 183 pp. (translated into 5 languages).

(b) Chapters in collective volumes.

1. **Shpigel, M.** (1983). The Serranidae. In: Encyclopedia of Plant and Animal Life in Israel, Vol. 1, Society for the Protection of Nature, Israel Defense Ministry Publ., pp. 165-167 (in Hebrew).
2. Lawrence, J.M., McBride, S.C., Plank, L.R. and **Shpigel, M.** (2003). Ammonia tolerance of the sea urchins *Lytechinus variegatus*, *Arbacia punctulata*, *Strongylocentrotus franciscanus*, and *Paracentrotus lividus*. In: Echinoderm Research 2001. Feral & David (Eds.), pp. 233-236. Swets & Zeitlinger, Lisse.
3. **Shpigel, M.** (2005). The use bivalves as biofilters and valuable product in land based aquaculture systems-review. In: The Comparative Roles of Suspension-Feeders in Ecosystems. Dame, R. and Olenin, S. (Eds). Kluwer Academic Pub., Dordrecht, The Netherlands, 400 pages.
4. Neori, A. and **M. Shpigel** (2006). Algae: key for sustainable mariculture. In: *Seaweed Resources of the World* (Critchley, AT, M. Ohno, DB Largo, Eds.), ETI Bioinformatics, University of Amsterdam (a book and a DVD disk).
5. Neori, A. and **M. Shpigel** (2006). An integrated system for farming fish, seaweed and abalone (an invited contribution). In: *CAB International Aquaculture Compendium*. Online at www.cabicompendium.org/ac. Wallingford, UK.
6. **Shpigel, M.** and Neori, A. (2007) Evaluation of macroalgae, microalgae, and bivalves as biofilters in sustainable land-based mariculture systems. In: Ecological and Genetic Implications of Aquaculture Activities Theresa M. Bert, (Ed.). Kluwer Publications, Dordrecht, the Netherlands.
7. **Shpigel, M** (2009). Coral nutrition. In; working with aquarium corals. Leewis, R., Wijgerde, T., Laterveer, M and Osing, R (Eds.) The European Association for Zoos and Aquaria.
8. **Shpigel, M.** (2013). Mariculture systems, Integrated Land-Based. In: *Sustainable Food Production*. Springer Science, N.Y. PP. 111-1120.

9. **Shpigel, M.** (2015). Land-Based Integrated Multi-Trophic Mariculture System. I. *In: Encyclopedia of Sustainability Science and Technology. Springer Science, N.Y.*
10. **Shpigel, M.** (2013). Environmentally friendly mariculture. *In: Glory of the sea: Stability and Change in the Aquatic Systems of Israel.* N. Stambler, Lotan T., Berman Frank, I. (Eds.). The Israeli Association of Aquatic Sciences. 457pp (In Hebrew).
11. Neori, A., **Shpigel, M.**, Guttman, L., Israel, A. (**submitted**). Chapter 5. The Development of Integrated Multi-Trophic Aquaculture (IMTA) in Israel. *In: Greening the Blue Revolution: The Turquoise Revolution of Integrated Multi-Trophic Aquaculture (IMTA)* (Chopin, T., Neori, A., Robinson, S. and Troell, M., Eds.). Springer Publishers, Dordrecht.

(c) Refereed articles/letters in scientific journals

1. **Shpigel, M.** (1982). Niche overlap among two species of coral dwelling fishes of the genus *Dascyllus* (Pomacentridae). Env. Biol. Fish. 7(1): 65-68.
2. **Shpigel, M.** and Fishelson, L. (1983). Ecology and sociobiology of coexistence in two species of *Dascyllus* (Pomacentridae, Teleostei). Bull. Inst. Oceanogr. Fish. 9: 207-224.
3. Diamant, A and **Shpigel, M.** (1985). Interspecific associations of groupers Serranidae, Teleostei) with octopus and moray eels in the Northern Red Sea. Env. Biol. Fish. 13: 153-159.
4. **Shpigel, M.** and Fishelson, L. (1986). Behavior and physiology of two species of *Dascyllus* (Pomacentridae, Teleostei). Env. Biol. Fish. 17:253-261.
5. **Shpigel, M.**, Coon, S.L. and Kleinot, P. (1989). Growth and survival of cultchless spat of *Ostrea edulis* Linnaeus, 1750 produced using epinephrine and shell-chips. J. Shellfish. Res. 8(2): 355-357.
6. **Shpigel, M.** (1989). Gametogenesis of the European Flat oyster (*Ostrea edulis*) and Pacific oyster (*Crassostrea gigas*) in warm water in Israel. Aquaculture 80(3-4):343-349.
7. **Shpigel, M.** and Fishelson, L. (1989). Food habits and feeding behavior of Red Sea groupers *Cephalopholis* (Serranidae, Teleostei) Env. Biol. Fish. 24:67-73.
8. **Shpigel, M.** and Fishelson, L. (1989). Habitat partitioning between species of the genus *Cephalopholis* (Pisces, Serranidae) across the fringing reef of the Gulf of Aqaba (Red Sea). Mar. Ecol. Prog. Ser. 58(1-2):17-22.
9. **Shpigel, M.** and Fridman, R. (1990). Propagation of the Manila clam *Tapes semidecussatus* in the effluent of fish aquaculture ponds in Eilat, Israel. Aquaculture 90(2): 113-122.
10. Gordin, H., Krom, M., Neori, A., Popper, D., Porter, C. and **Shpigel, M.** (1990). Intensive integrated seawater fish ponds: Fish growth and water quality.

In: Research in Modern Aquaculture. H. Rosenthal and S. Sarig
Aquaculture Society, Special Publication No.11. pp. 45-64.

11. **Shpigel, M.** and Fishelson, L. (1991). Territoriality and associated behavior in three species of the genus *Cephalopholis* (Pisces: Serranidae) in the Gulf of Aqaba, Red-Sea. J. Fish Biol. 38(6): 887-896.
12. **Shpigel, M.** and Fishelson, L. (1991). Experimental removal of piscivorous groupers of the genus *Cephalopholis* (Serranidae) from coral habitats in the Gulf of Aqaba. Environ. Biol. Fish. 31(2): 131-138.
13. **Shpigel, M.** and Blaylock, R.A. (1991). The Pacific oyster *Crassostrea gigas*, as a biological filter for marine fish aquaculture pond. Aquaculture 92(2-3):187-197.
14. Sami, S., **Shpigel, M.** and Faisal, M. (1991). Comparison between the host defense mechanisms of diploid and triploid oysters *Crassostrea gigas*: effect of thermal stress on hemocyte surface Concanavalin A-binding sites. Zeitschrift fur Angewandte Zoologie 78(1): 69-78.
15. **Shpigel, M.**, Barber, B.J. and Mann, R. (1992). Effects of elevated temperature on growth, gametogenesis, physiology and biochemical composition in diploid and triploid Pacific oysters, *Crassostrea gigas* Thunberg. J. Exp. Mar. Biol. Ecol. 161(1): 15-25.
16. **Shpigel, M.**, Lee, J., Soohoo, B., Fridman, R. and Gordin, H. (1993). Use of effluent water from fish-ponds as a food source for the pacific oyster *Crassostrea gigas* Thunberg. Aquaculture Res. 24(4): 529-543.
17. **Shpigel, M.**, Neori, A., Popper, D.M. and Gordin, H. (1993). A proposed model for "environmentally clean" land-based culture of fish, bivalves and seaweeds. Aquaculture 117: 115-128.
18. Allen, S.K., **Shpigel, M.**, Utting, S. and Spencer, B. (1994). Incidental production of tetraploid Manila clams *Tapes philippinarum* (Adams and Reeve). Aquaculture 128(1-2): 13-19.
19. **Shpigel, M.** and Spencer, B. (1996). Performance of diploid and triploid Manila clams (*Tapes philippinarum*, Adams and Reeve) at various levels of tidal exposure in the UK and in water from fishponds at Elat, Israel. Aquaculture 141(3-4): 159-171.
20. **Shpigel, M.** and Neori, A. (1996). The integrated culture of seaweed, abalone, fish and clams in modular intensive land-based systems: I. Proportion of size and projected revenues. Aquacultural Engineering 15(5): 313-326.
21. **Shpigel, M.**, Marshall, A., Lupatsch, I., Mercer, J.P. and Neori, A. (1996). Acclimation and propagation of the abalone *Haliotis tuberculata* in land-based culture system in Israel. J. World Aquaculture Soc. 27(4): 435-442.

22. **Shpigel, M.**, Neori, A. and Marshall, A. (1996). The suitability of several introduced species of abalone (Gastropoda: Haliotidae) for land-based culture with pond grown seaweed in Israel. Israeli Journal of Aquaculture/Bamidgeh 48(4), pp. 192-200.
23. **Shpigel, M.**, Gasith, A. and Kimmel, E. (1997). A biomechanical filter for treating fish-pond effluents. Aquaculture 152(1-4):103-117.
24. Neori, A., Ragg, N.L.C. and **Shpigel, M.** (1998). The integrated culture of seaweed, abalone, fish and clams in intensive land-based systems: II. Performance and nitrogen partitioning within integrated abalone (*Haliotis tuberculata*) and macroalgae (*Ulva lactuca* and *Gracilaria conferta*) culture system. Aquacultural Engineering 17(4):215-239.
25. **Shpigel, M.**, Ragg, N. C. Lupatsch, I. and Neori, A. (1999). Protein content determines the nutritional value of the seaweed *Ulva lactuca* for the abalone *Haliotis tuberculata* and *Haliotis discus hannai*. J. Shellfish Res. 18 (1): 227-233.
26. Neori, A. and **Shpigel, M.** (1999). Using algae to treat effluents and feed invertebrates in sustainable integrated mariculture. World Aquaculture 30(2): 46-51.
27. **Shpigel, M.**, Ragg, N. C. Lupatsch, I. and Neori, A. (1999). Protein content determines the nutritional value of the seaweed *Ulva lactuca* for the abalone *Haliotis tuberculata* and *Haliotis discus hannai*. J. Shellfish Res. 18 (1): 227-233.
28. Neori, A, Shpigel, M. and Ben-Ezra, D. (2000). The integrated culture of seaweed, abalone, fish and clams in modular intensive land-based systems: III. Fish, seaweed and abalone. Aquaculture 186(3-4): 279-291.
29. McBride, S.C., Rotem, E., Ben-Ezra, D., and **Shpigel, M.** (2001). Seasonal energetics of *Haliotis fulgens* (Philippi) and *Haliotis tuberculata* (L.). J. Shellfish Res. 20(2): 659-665.
30. Boarder, S.J. and **Shpigel, M.** (2001). Comparative performances of juvenile *Haliotis roei* fed on enriched *Ulva rigida* and various artificial diets. J. Shellfish Res. 20(2): 653-659.
31. **Shpigel, M.**, Neori, A. and Zmora, O. (2002). Sustainable land-based mariculture in arid environment. The Sea Urchin: From Basic Biology to Aquaculture. Sea Urchin Aquaculture, advanced workshop. Torregrande, Sardinia, Italy. pp. 139-144
32. Lee, J.J., **Shpigel, M.**, Freeman, S., McLeod, S., Bowen, S., Pearson, M. and Szostek, S. (2003). Physiological ecology and possible control strategy of a toxic marine Dinoflagellate, *Amphidinium* sp., from the benthos of a mariculture pond. Aquaculture 217: 351-371.

33. Schuenhoff, A., **Shpigel, M.** Lupatsch, I., Ashkenazi, A., Msuya, F.E. and Neori, A. (2003). A Semi-Commercial, Integrated System for the Culture of Fish and Seaweed. Aquaculture 221(1-4): 167-181.
34. Neori, A., Msuya, F.E., Shauli, L., Schuenhoff, A., Lupatsch, I. and **Shpigel, M.** (2003). A novel three-state *Ulva lactuca* biofilter design for integrated mariculture: fast and efficient ammonia uptake rates and high yields of protein-rich biomass. J. Applied Phycology 15:543-553.
36. Lee, J., **Shpigel, M.**, Olea, R., Pochon, X, Cevalco, M., and Pawlowski, J. (2004). A toxic marine dinoflagellate, *Amphidinium eilatensis*, sp. nov., from the benthos of a mariculture sedimentation pond in Eilat, Israel. J. Euk. Microbiology 50 :(6) 439-448.
37. Neori, A., Chopin, T., Troell, M., Buschmann, A.H., Kraemer, G.P., Halling, C., **Shpigel, M.** and Yarish, C. (2004). Integrated aquaculture: rationale, evolution and state of the art emphasizing seaweed biofiltration in modern mariculture. Aquaculture 231: 361-391
38. **Shpigel, M.**, McBride, S.C., Marciano, S. and Lupatsch, I. (2004). The effect of photoperiod and temperature on the reproduction of European sea urchin, *Paracentrotus lividus*. Aquaculture 232:343-355.
39. Gordon, N., **Shpigel, M.**, Harpaz, S., Lee, J.J. and Neori, A. (2004). The settlement of abalone (*Haliotis discus hannai*) larvae on culture layers of different diatoms. J. Shellfish Res. 23(2): 561-568.
40. Lee, J., Rodriguez, D., Zmora, O., Neori, A, Symons, A. and **Shpigel, M.** (2004). Transition from earthen sedimentation ponds in integrated mariculture systems to ones lined with PVC, what needs to be done. J. Applied Phycology 16: 341-353.
41. Hadas, E., **Shpigel, M.**, and Ilan, M. (2005). Sea ranching of the marine sponge *Negombata magnifica* (Demospongiae, Latrunculiidae) as a first step for latrunculin-B production. Aquaculture 244:159-169.
42. **Shpigel, M.** McBride, S.C., Marciano, S., Ron, S., and Ben-Amotz, A. (2005). Improving gonad colour and somatic index in the European sea urchin *Paracentrotus lividus*. Aquaculture 245:101-109.
43. Schlosser, S., Lupatsch I., Lawrence, J., Lawrence, A., **Shpigel, M.** (2005). Protein and energy digestibility and gonad development of the European sea urchin *Paracentrotus lividus* (Lamarck) fed algal and prepared diets during spring and fall. Aquaculture Research 36 (10): 972-982.
44. Hadas, E., Marie, E., **M. Shpigel** and Ilan, M. (2006). Virus predation by sponges is a new nutrient flow pathway in the coral reef food web. Limnology & Oceanography 51(3):1548-1550.

45. Gordon, N, Neori, A., Harpaz, S., Lee, J.J., and **Shpigel, M.** (2006). Effect of diatom diets on growth and survival of the abalone *Haliotis discus hannai* postlarvae. *Aquaculture* 252:225-233.
46. Zmora, O., and **M. Shpigel** (2006). Intensive mass production of *Artemia* in a recirculated system. *Aquaculture* 255:488-494.
47. **Shpigel, M.** S. Schlosser, A. Ben-Amotz, A.L. Lawrence, J. M. Lawrence (2006). Effect of dietary carotenoid on the gut and the gonad of the sea urchin *Paracentrotus lividus*. *Aquaculture* 261; 1269-1280.
48. Hadas, E., **M. Shpigel, M. Ilan** (2008). Oxygen consumption by coral reef sponge. *The Journal of Experimental Biology*: 211:2185-2190.
49. Stuart B. and **M. Shpigel** (2009). Evaluating the economic potential of horizontally integrated land-based marine aquaculture. *Aquaculture*: 294:43-51.
50. Hadas, E., **M. Shpigel, M. Ilan** (2009). Particulate organic matter as a food source. *The Journal of Experimental Biology* 212(22): 3643-3650.
51. Wegi W. A., **M. Shpigel** and M. Sagi (2010). Molybdenum application and its effects on the molybdenum-enzymes NR and XDH in sea water irrigated *Salicornia*. *Sciatic Horticult* 126: 395-401.
52. Ventura, Y., Wegi W., Myrzabayeva, M., Alikulov, Z., **Shpigel, M.** Samocha, T and M. Sagi (2011). Effect of seawater concentration on the productivity and nutritional value of annual *Salicornia* and perennial *Sarcocornia* halophytes as leafy vegetables crops. *Sciatic Horticult*: 128, 189-196.
53. Bergman, O., Haber, M. Mayzel, B. Anderson, M.A. **Shpigel, M.** Hill, R. and Ilan, M (2011). Marine based cultivation of *Diacarnus* sponges and the bacterial community composition of wild and maricultured sponges and their larvae. *Marine Biotechnology* 13 (6) 1169-1182.
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(d) Proceedings of symposia

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(e) Unreformed professional articles and publications

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2. **Shpigel, M.** (1988). With the fish. Yam Magazine 1:38.

3. **Shpigel, M.** (1988). The Cleaner Wrasse. Yam Magazine. 3:32-33.
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(f) Final Project Reports

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2. **Shpigel, M.** (1999). Evaluation the Possibilities of Setting-up Commercial Integrated System of Fish-Abalone-Seaweed in WA. Report to the South Metropolitan College of Tafe.
3. **Shpigel, M.** (2001). Development of commercial system for growing abalone in Israel for market and export. Ministry of Industry and Commerce, Feb. 1999. EU Project. Contract 18192.
5. **Shpigel, M.** and Mercer, J.P. (2001). Development of an integrated environmentally friendly polyculture of abalone, finfish and seaweed in a land based facility. EU Project. INTAB 206421.
7. **Shpigel, M.** and Place, A. (2001). Development of sodium alginate encapsulation of diatom concentrates as a nutrient delivery system to enhance growth and survival of post-larvae abalone (*Haliotis* spp.). BARD, Project No. IS-3115-99.
8. **Shpigel, M.** and Lawrence, A. (2001). Pilot scale production of the edible sea urchin *Paracentrotus lividus* in an environmentally friendly land-based facility: Effect of photoperiod, temperature and diet on gonad production. Texas-Israel TDA-TIE 845-4782.
9. **Shpigel, M.** (2003). A pilot scale environmentally friendly, land based integrated system for the production of shrimp, fish and seaweed. Texas-Israel TDA-TIE.
10. Lubzenth, E., and **Shpigel, M.** (2003): Development of culture system for shrimps (*Penaeus semisulcatus*) in sustainable land based system. **MAGNETON**. The Ministry of Industry and Commerce 2003.
11. **Shpigel, M.** (2003). Domestication of the purple sea urchin, *Paracentrotus lividus*, in environmentally friendly land-based facilities: growth rates, survival and product quality. Ministry of Agriculture. Contract No. 894-0125-00.
12. **Shpigel, M.,** Place, Allen and Koven, B., (2004). The development of sodium alginate encapsulation of diatoms concentrates as a nutrient delivery to
13. enhance growth and survival of abalone. Final Report, BARD.
13. **Shpigel, M.** (2005). Development of generic approach to sustainable integrated marine aquaculture for European environments and markets (**GENESIS**). EU Commission IPS contract 2000-00102.

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15. **Shpigel, M.** (2005) Development of generic approach to sustainable integrated marine aquaculture for European environments and markets. GENESIS-EU Commission IPS contract 2000-00102.
16. **Shpigel, M.** (2007). Sea urchin production in integrated systems, their nutrition and roe enhancement.
17. **Ilan, M., Shpigel, M., Hill, R.T.** (2008). Novel marine Natural products from sponges and microorganisms. Final Report, project IS-3115-99. BARD.
18. **Shpigel, M.** (2009). Improving in-situ and ex-situ mass culturing methodologies of exotic marine invertebrates for the ornamental trade and public aquaria. CORLAZOO-EU project.
19. **Shpigel, M.** (2010) European Economic Community., Improvement of the cost effectiveness of marine land-based aquaculture facilities through use of Constructed Wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product. Envirophyte-EU project.
20. **Shpigel, M.** (2011). Enrichment of aquaculture systems by introduction of commercially underdeveloped marine species from different trophic levels. Final Report, ENRICH- EU-project.
21. **Shpigel, M.** (2011). Hamed Abdel Rahman. Integration of Gilthead Seabream, *Sparus aurata*, Culture with Shellfish and Seaweeds in a IMTA System to Increase Profitability and Reduce Environmental Enrichment. Final Report submitted to the U.S. AID.
22. **Shpigel, M.** (2011). Cultivation of the halophyte *Salicornia* sp. in constructed wetlands for purification of shrimp effluent water and production of biodiesel fuel. Final Report submitted to BARD.
23. **Shpigel, M.** (2013). Integration of the IMS project with the development of all female mullet populations to improve production and the enhancement of egg roe for Batarekh/Karasumi production. Final Report submitted to MERC-USAID.
24. **Shpigel, M.** (2016). Research & technological development to improve economic profitability and environmental sustainability of sea urchin farming. Final Report submitted to RESURCH EU project.

(g) Published scientific reports and technical papers

1. **Shpigel, M.** (1999). 1. Improvement of survival and growth of post-larval abalone; 2. Optimisation of the integrated system; 3. Growth and culture and management of the sea urchin *Paracentrotus lividus*; 4. Abalone and sea urchin research in the Mediterranean Sea. Steering Committee, Nov. 1999, Ministry of National Infrastructures.
2. **Shpigel, M.** (2000). 1. Integrated systems (abalone, fish, seaweed); 2. Sea urchins: effect of various feeds on gonad growth and colour. Steering Committee, Nov. 2000. Ministry of National Infrastructures.
3. **Shpigel, M.** (2001). 1. Integrated systems; 2. Abalone conditioning unit; 3. Sea urchins: light and temperature effects on gonadal growth and structure.

Steering Committee, Nov. 2001. Ministry of National Infrastructures.

4. Boarder, S.J. and **Shpigel, M.** (2002). Comparative performances of juvenile *Haliotis roei* fed on artificial diet. Provided to Adam & Amos abalone foods. www.adamamos.com.
5. **Shpigel, M.** (2002). 1. Incorporation of the shrimp *Penaeus semisulcatus* into integrated systems; 2. Domestication of the sea urchin *Paracentrotus lividus* for environmentally friendly mariculture: improvement of growth rates, survival and product quality. Steering Committee, Nov. 2002. Ministry of National Infrastructures.
6. Kissil, G.Wm., Lupatsch, I. and **Shpigel, M.** (2003). Evaluation of the accumulation of Lycopene from Lycopersicon in the green tiger prawn, *Penaeus semisulcatus* and the gilthead seabream, *Sparus aurata*. Report to LycoRed, Ltd.
7. **Shpigel, M** (2003). 1. Rearing of shrimps in semi-recirculated system. 2. Development of protocol for growing shrimps at larval stage in hatchery and post larval stage in conditioning unit. 3. Development of protocol for post larval rearing. 4. Oxygen consumption and ammonia excretion in urchins exposed to pellets and macro algae. 5. Effect of density on post larval growth rates. Steering Committee, Nov. 2003. Ministry of National Infrastructures
8. **Shpigel, M** (2004). 1. Environmentally friendly growing system based on Constructed wetlands for effluent treatment. 2. Optimisation of sea urchin growing, gonadal quality, and examination of feed. 3. Mariculture – innovative methods of growing the red sponge *Negombata magnifica* in the sea. 4. Scientific support for commercial entities. Steering Committee, Nov. 2004. Ministry of National Infrastructures
9. **Shpigel, M** (2005). 1. Integrated systems GENESIS project. 2. Incorporating sea urchins into the integrated system (SPIINES). 3. Sea ranching of marine sponges (BARD). 4. Learning the nutritional requirements of stony corals (CoralZoo). Steering Committee, Nov. 2005. Ministry of National Infrastructures.
10. **Shpigel, M** (2006). 1. Incorporating sea urchins into the integrated system (SPIINES). 2. Learning the nutritional requirements of stony corals (CoralZoo). 3. Sea ranching of marine sponges for natural substances (BARD). Steering Committee, Nov. 2006. Ministry of National Infrastructures.

- **Research grants:**

- A. International Competitive Grants**

1. 1985-1988: United States - Israel Binational Agricultural Research and Development (BARD). "Oyster production in the outflow of salt water fish ponds" (**Co-investigator** in 1985 and **PI** in 1986-1988). **\$150,000** Researcher's part **\$75,000**
2. 1994-1997: European Economic Community. **INTAB**. Develop a technology for polyculture of seaweed and macroalgivores on fishpond effluents. **PI of the project. Investigator. \$450,000** Researcher's part **\$113,800**.
3. 1996: European Economic Community. Development of environmentally friendly technologies for recycling nutrients from fish farm cages: phyco-depuration and secondary crop production. **Co-investigator** in a grant of **45,000 Euro** Researcher's part **EU 10,000**.
4. 1998-2000: European Economic Community and the Ministry of Science and Technology of Israel to develop a pilot system for polyculture of seaweed and macroalgivores on fishpond effluents. **PI of the project. Budget: 1,710,000 Euro.** Researcher's part: **EU 171,000**.
5. 1999-2001: Texas Israel Exchange Fund Program. Pilot scale production of the edible sea urchin, *Paracentrotus lividus*, in environmentally friendly land-based facilities: effect of photoperiod, temperature and diet on gonad production. \$100,000, **PI of the project. Researcher's part: \$49,550**.
6. 2000-2001: Binational Research and Development (BARD). The development of sodium alginate encapsulation of diatom concentrates as a nutrient delivery system to enhance growth and survival of post larval abalone. **PI of the project. \$100,000. Researcher's part \$50,000**.
7. 2001-2003: Texas Israel Exchange Fund Program. A pilot scale environmentally friendly, land based integrated system for the production of shrimp, fish and seaweed. **PI of the project. \$108,000. Researcher's part \$54,000**
8. 2001-2004: European Economic Community. **GENESIS**. Polyculture for bio-purification of fish farm effluents; Culturing of bivalves and macroalgivores to convert macro and micro-algae from mariculture effluent biofilters into high value crops (abalone and sea urchin). **M. Shpigel coordinator of the project. Budget: 2,500,000 Euro. Researcher's part: 230,000 Euro.**
9. 2004-2007: European Economic Community. **SPIINES**, Sea urchins in integrated systems, their nutrition and roe enhancement: **Budget: 806,213 Euro. P PI of the project. Researcher's part: 147,554 Euro.**
10. 2004-2007: **BARD**. Novel marine natural products from sponges and associated microorganisms, **Budget \$ 288, 000. CO. Researcher's part: \$ 75,000.**

11. 2005-2009: **CORALZOO**. European Economic Community. Improving in-situ and ex-situ mass culturing methodologies of exotic marine invertebrates for the ornamental trade and public aquaria. **PI of the project. Budget 2, 610, 000 Euro.** Researcher's part: **255,000 Euro.**
12. 2006-2009: **ENVIROPHYTE**. European Economic Community., Improvement of the cost effectiveness of marine land-based aquaculture facilities through use of Constructed Wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product. **M. Shpigel coordinator of the project.. Budget 1,644,550 Euro.** Researcher's part: **\$ 226,000 Euro.**
13. 2007-2010: **MERC-USAID**. Integration of Gilthead Sea bream, *Sparus aurata*, Culture with Shellfish and Seaweeds in a Polyculture System to Increase Profitability and Reduce Environmental Enrichment. **PI of the project. Budget \$ 496,100.** Researcher's part: **\$ 243,650.**
14. 2008-2011; **Enrich**. Enrichment of aquaculture systems by introduction of commercially underdeveloped marine species from different trophic levels. **PI of the project. Budget 1,108,000 Euro,** Researcher's part: **117,300 Euro.**
15. 2008-2011; **BARD (Texas)**. Cultivation of the halophyte *Salicornia* sp. in constructed wetlands for purification of shrimp effluent water and production of biodiesel fuel. **PI of the project. Budget \$360000.** Researcher's part: **\$ 90,000.**
16. 2010-2013: **MERC-USAID**. Integration of the IMS project with the development of all female mullet populations to improve production and the enhancement of egg roe for Batarekh/Karasumi production. **PI of the project. Budget \$ 496,100.** Researcher's part: **\$ 122,650.**
18. 2013-2016: **RESURCH**. Research & technological development to improve economic profitability and environmental sustainability of sea urchin farming. **PI of the project 1.108.900 Euros budget. Researcher part 88,000 Euros.**
19. 2017-2020: **COST action**, EU COST Action "Oceans Past Platform" (travel expenses).
20. 2017-2020: **BARD**. Use of plant based biofilters to create sustainable mariculture systems. **CO: budget \$360000.**

B. National Competitive Grants

1. 1994-1998: **MAGNETON** (with SeaOr Marine Ltd.), to develop commercial integrated culture of abalone in Israel. PI of the project. The initiative is funded by a grant of \$300,000 from the Ministry of Industry and Commerce and an additional \$150,000 from Seamor Marine Ltd
2. 1997-1998: **MAGNETON**, the Ministry of Industry and Commerce. Biotechnology of algal cultivation and product development (principal investigator Dr. M. Friedlander). Co-investigator. Budget: \$ 200,000. **Researcher's part: \$12,000.**

3. 2000-2003: **Ministry of Agriculture.** Domestication of the purple sea urchin, *Paracentrotus lividus*, in environmentally friendly land-based facilities: growth rates, survival and the quality of the product. PI of the project. \$155,000.
4. 2001-2003: **MAGNETON**, the Ministry of Industry and Commerce. Development of culture system for shrimps (*Penaeus semisulcatus*) in sustainable land based system. PI of the project. Budget: \$350,000. Researcher's part: \$90,000.
6. 2013-2016: **IKA.** Use of *Salicornia* and *Sarcocornia* in constructed wetlands to treat effluents from intensive fish mariculture systems and its production as a high value, marketable commodity. PI of the project. Budget: \$59,000. Researcher's part: \$40,000.
- 6.. 2019-2021: **Ministry of Agriculture.** budget 890,000 ISL Researcher's part: 890,000.
7. 2020-2022: **Ministry of Science.** Exploring perennial *Sarcocornia* as a halophyte biofilter for mariculture effluents and a source for lucrative foods and biochemicals. Budget: 389000 ISL.

C. Other Research Grants

1. 1981-1982: Council for Development of Sinai Peninsula, to study the ecology and biology of the red sea groupers of the genus *Cephalopholis*. Principal Investigator \$15,000
2. 1991-1992: Negev Arava R&D Network, the Jewish Agency (MOP Arava), to study bivalves as a biofilter in fishpond effluents. Principal Investigator \$25,000
3. 1992-1993: Negev Arava R&D Network, to study and develop biomechanical filters for fishpond effluents. Principal Investigator \$30,000
4. 1994-1995: Negev Arava R&D Network, to develop a pilot scale fish, bivalve seaweed integrated system (Principal investigators: H. Gordin and N. Mozes). Co-investigator. \$120,000
5. 1995-1996: NOAA, USA for a preliminary joint project with Prof. Roger Mann (USA) and Dr. Raouf Kilada (Egypt) for a field survey to study *Tridacna* sp. populations in the Gulf of Aqaba. Principal Investigator. \$22,000 Researcher's part \$8,000
6. 1996-1997: Irish government, for program on international collaboration. The role of artificial diet supplement and grow-out techniques in the development of the Irish echiniculture industry. \$2,000
7. 2001: LycoRed firm, to evaluate the use of Lycopene in shrimps. \$12,000 Researcher's part \$16,000.

8. 2008-2009: North American friends. Using fish ponds effluent water to culture stony coral. Principal Investigator Researcher's part \$18,000.

- **Lectures and presentations at meetings and invited seminars.**

(a) **Invited plenary lectures at conferences/meetings**

A.1. Plenary session speaker (funded by the inviting organization or institution -*)

2003*: Invited as **plenary session speaker and session co-chair** to European Aquaculture Society conference in Trondheim, Norway, 12-15 August 2003. See "29" above.

2007*: Invited to be **plenary session speaker** and **chairman** to IMARES 10th Intl. Conference on Shellfish Restoration (ICSR) in Vissingen, the Netherlands, 12-17 Nov. 2007.

2018* Invited to be **plenary session speaker** and **chairman** to 2nd International Fisheries and Aquaculture August 12-13, Amsterdam, the Netherland

a. 2. Keynote speaker (funded by the inviting organization or institution -*)

1999*: Invited **as a keynote speaker** by the US National Aquaculture Association to present a paper on sustainable mariculture in Israel. Aquaculture America 99, Tampa, FL. USA.

1999*: Invited **as a keynote speaker and chairman** by the World Aquaculture Society to the World Aquaculture meeting in Sydney, Australia to present a paper on sustainable integrated mariculture. Sydney, Australai.

2001*: Invited **as a keynote speaker and chairman** to the World Aquaculture conference in Orlando, Florida, USA.

2002*: Invited **as a keynote speaker and a chairman** to the World Aquaculture Conference in Beijing, China, presenting paper on "Integrated Mariculture Systems: An Overview".

2003*: Invited **as a keynote speaker** to International Organic Aquaculture Workshop, Minneapolis, Minnesota, USA.

2003*: Invited as **a keynote speaker** by Queensland Conservation Council and the Australian Marine Conservation Society to conference on marine aquaculture entitled "Putting the Green Back into the Blue". August 2003. Brisbane, Australia.

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- 2003*. **Invited as a keynote speaker to NATO** meeting. Advanced Research Workshop on "The Comparative Roles of Suspension Feeders in Ecosystems" The use of edible bivalves as a biofilter from fishpond effluents. October 2003. Nida, Lithuania, in.
- 2009: Invited as a **keynote speaker and chairman** to the European Aquaculture Society meeting. Multi-Trophic Systems: Benefits and Constraints. August 2009. Trondheim, Norway.
- 2012 * Invited by the EU **as a keynote speaker** for the EU-Mediterranean conference on research and innovation to present a paper on "An Ecosystem based approach for fisheries and aquaculture". April 2012. Barcelona, Spain.
- 2013* Invited **as a keynote speaker** to the Conference "Third Marine Eco-Civilization Forum". Paper presented: Eco-Civilization and Future Oriented Mariculture. 26-29 September 2013, Wenzhou, China.
2013. Invited as **a keynote speaker** to the Asian Pacific Aquaculture conference in Ho Chi Min Vietnam. Integrated multi-trophic mariculture systems: an ecological approach for sustainable aquaculture. December 2013. Hanoi, Vietnam.
- 2014* Invited **as a keynote speaker and Chairman** to the 24th Pacific Congress on Marine Science and Technology PACON 2014. Integrated Multi-Trophic Mariculture Systems: An Ecological Approach for Sustainable Aquaculture . September 2014. Xian, China
- 2015 Invited **as a keynote speaker** to the 197th annual meeting of the National Shellfisheries Association (2015). Integrated Multi-Trophic Mariculture Systems: benefits and constrains. March 22-26, Monterey CA USA.
- 2017*: Invited **as a keynote speaker** to the International Seaweed Symposium, IMTA in Wando Seaweeds Expo 2017. April 14-18, Wando, Korea
- 2017*: Invited **as a keynote speaker** to the International Symposium on the IMTA, at the National Institute of Fisheries Science September 14-15, 2017. Busan, Republic of Korea.
- 2018*: Invited **as a keynote speaker** to the *The 10th edition of the* "Rendez-Vous de Concarneau: where Industry meets Science in marine biotechnology" *will take place this year* on October 12th 2018. Concarneau France.

a. Invited as Chairman and speaker:

- 1997: Invited as **chairman and speaker** to 3rd International Abalone Symposium in Monterey, CA, USA.
- 2000*: Invited as chairman and speaker by the World Aquaculture Society special session conference in Nice, France in 2000 and to present a paper on biofilters in mariculture systems.
- 2000: Invited as **chairman and speaker** to 4th Intl. Abalone Symposium, Capetown, South Africa.

- 2003: Invited as **chairman and speaker** to International Conference of Fisheries & Aquaculture, Puerto Varas, and Chile and to present paper on "Domestication of the European sea urchin (*Paracentrotus lividus*) in Israel".
- 2006: Invited as **chairman and speaker** of Sea Urchin Aquaculture and Fisheries session of the National Shellfisheries Association conference in Monterey, CA, USA in March 2006.
- 2006*: Invited as a **session organizer** and as **chairman** to the World Aquaculture conference in Florence, Italy in May 2006.
- 2006: Invited as **chairman and a speaker** of the 12th International Echinoderm Conference in New Hampshire, USA, 7-11 August 2006.
- 2006: Invited as **a chairman** to 10th Annual Dan Popper Symposium in Eilat, Israel, 20 February 2006.
- 2007: Invited as **chairman and speaker** to IMBC 2007 8th Intl. Marine Biotechnology Conference in Eilat, Israel, 11-16 March 2007.
- 2008: Invited as **chairman and moderator** to the World Aquaculture Society meeting in Busan, South Korea in May 2008.
- 2020: Invited as **chairman and speaker** to 3rd India International Seaweed Expo&Summit 2020.

A. 4. Invited as speaker

- 1990*: Invited to the 10th Annual Shellfish Biology Seminar in the Northeast Fisheries Center Milford Laboratory, Connecticut, USA. Paper presented: "The integrated aquaculture system in Israel."
- 1997*: Invited by the organizing committee to the 4th International Marine Biotechnology Conference. Sorrento, Italy. 22-29 September. Paper presented: "Integrated system in Israel".
- 1998*: Invited by Sea Grant Extension Program to the conference of Marine Aquaculture: Emerging Technologies and Opportunities. Stamford, CT, USA. Paper presented: "Sustainable mariculture system."
- 2012 Invited to the Conference on Marine Environment and Aquaculture. Paper presented: "IMTA systems cost and benefit". Zhejiang Association of Sciences and Technologies. Wenzhou, China 91-3 November.

(a) Presentations at international seminars and workshops

1 International Workshops

1. 1993: Invited as **speaker** to workshop on fish farm effluents and their control in EC countries. Hamburg, Germany. November 23-25. "The use of the Pacific oyster, *Crassostrea gigas*, as a biological filter for marine fish aquaculture ponds."
2. 1994: Invited as **speaker** to the Second Japanese-Israeli Symposium on Aquaculture. Kagoshima University, Japan. Paper presented: "Culturing of abalone, *Haliotis tuberculata*, to convert seaweed from mariculture effluent biofilter into high value crop."
3. 1996: Invited as **speaker** to workshop by the University of Galway as a part of a "programme on international collaboration in Ireland". Presentation: "The

role of artificial diet supplement and grow-out techniques in the development of the Irish echinoculture industry."

4. 2003: Invited as **keynote speaker** to NATO Advanced Research Workshop on "The Comparative Roles of Suspension Feeders in Ecosystems" in Nida, Lithuania, in October 2003.
5. 2005: Invited as a **speaker** to EFARO (European Fisheries Aquaculture Organisation) to present a paper on "State of the art and future developments of integrated systems" in February 2005.
6. 2005: Invited as **speaker** to Fishery Science Workshop in Qingdao, China via CIICTA 18-24 Nov. 2005.
7. 2010: Invited as **speaker** to the International Conference on Sea urchins aquaculture and restoration. Palermo, Italy. October, 7-10.
8. 2011 Invited to the International workshop on the status and management of the edible sea urchins *Paracentrotus lividus* in Mediterranean Sea. Palermo, 8-9 October
9. 2012: Invited as **speaker** to the Euro-Mediterranean conference on research and innovation. Barcelona, Spain. 2-3 April.
10. 2016: Invited as **keynote speaker** and Chairmen to APEC training workshop on coastal Eco aquaculture. Xiamen, China May 31-June 2, 2016.

(b) Presentation of papers by Shpigel at conferences/meetings (oral or poster).

1. **Shpigel, M.** (1980). The relationship between the spatial structure of branched corals and the species diversity of fishes. Zoological Society, Tel Aviv University. Isr. J. Zool. 29: 205.
2. **Shpigel, M.** (1985). The ecology and biology of the Red Sea groupers. Bien. Sci. Meet. of Interstate Inst. Interuniversity Institute, Elat, Israel, p. 18.
3. **Shpigel, M.** (1988). Gametogenesis and reproduction of *Crassostrea gigas* and *Ostrea edulis* in warm water system in Elat, Israel. Meeting of the Israeli Aquaculture Society. Haifa, Israel.
4. **Shpigel, M.** (1988). Mortality and diseases of *Crassostrea gigas* and *Ostrea edulis* in a warm system in Elat (Red Sea), Israel. Intl. Fish Health Conference, Vancouver, B.C., Canada.
5. **Shpigel, M.,** Lee, J.J. and Soohoo, B. (1989). Fish-oyster polyculture in warm water marine ponds. J. Shellfish Res. 8(2): 481.
6. **Shpigel, M** and Fridman, R. (1990). Bivalve culture in warm water marine ponds in Elat. 10th Annual Shellfish Biology Seminar, February 17-18, Milford, Connecticut, USA, p. 15. **7.**
7. **Shpigel, M,** Lee, J.J. and Shoocho, B. (1990). Fish-oyster mariculture in Elat, Israel. 82nd Annual Meeting of the National Shellfisheries Assoc., Inc. April, 1-5, Williamsburg, VA, USA, p. 481.

8. **Shpigel, M** and Fishelson, L. (1991). Results of removal of piscivorous groupers of the genus *Cephalopholis* from coral habitat. In the 27th Annual Meeting of the Zoological Society of Israel, Jerusalem Israel Journal of Zoology, 37(3): 163.
9. **Shpigel, M.**, Barber, B.J. and Mann, R. (1991). The effect of temperature on growth, physiology and gametogenesis in diploid and triploid pacific oyster *Crassostrea gigas* Thunberg. (Poster). June 10-12, Dublin, Ireland. European Aquaculture Society Special Publication No. 14. p. 294.
10. **Shpigel, M.**, Neori, A. and Gordin, H. (1991). Oyster and clam production in the outflow of marine fishponds in Israel. European Aquaculture Society. June 10-12, Dublin, Ireland. European Aquaculture Society Special Publication No. 14. p. 295.
11. **Shpigel, M.**, Neori, A., Popper, D.M and Gordin, H. (1992). A proposed model for "clean" land-based polyculture of fish, bivalves and seaweed. U.S-Israel Workshop on Mariculture and the Environment. June 8-10, Elat, Israel. pp. 43-55.
12. **Shpigel, M.**, Neori, A., Popper, D.M. and Gordin, H. (1992). A land-based polyculture of fish, bivalves and seaweeds. World Aquaculture Society Meeting. May 21-25, Orlando, Florida.
13. **Shpigel, M.**, Neori, A., Popper, D.M and Gordin, H. (1992). A proposed model for "clean" land-based polyculture of fish, bivalves and seaweeds. Abstracts of the Japanese-Israeli symposium on aquaculture Nov. 2-8, Haifa/Elat, Israel. Bamidgeh, 44(4): 147.
14. **Shpigel, M.**, Neori, A. Ben-Ezra, D. and Gordin, H. (1993). Polyculture for bio-purification of fish farm effluents. World Aquaculture Society Meeting. Torremolinos, Spain. p. 467.
15. **Shpigel, M.**, and Neori, A. (1994). Culturing of abalone (*Haliotis tuberculata*) to convert seaweed from mariculture effluents biofilter into high value crop. The Second Japanese-Israeli Symposium on Aquaculture. Kagoshima University, Japan. p.
16. **Shpigel, M.**, and Neori, A. (1994). *Haliotis tuberculata*, an herbivore for aquaculture biofilters. The 25th Annual Meeting. The Society for Ecology and Environmental Quality Sciences, Tel Aviv, Israel. p. 106. 1996: First Regional Symposium on Enhancement of Coastal Productivity in the Middle East Though Mariculture Development. Elat, October, 14-17. Paper presented: "Non-polluting mariculture systems."
17. **Shpigel, M** and Neori, A. (1995). The effect of temperature on growth, physiology and gametogenesis in diploid and triploid pacific oyster *Crassostrea gigas* Thunberg.. World Aquaculture Society Meeting. San Diego, CA, USA, February 1-5. Aquaculture 95 Book of Abstracts, p. 444. Publication no. 28, p. 647
18. **Shpigel, M** and Fishelson, L. (1996). The impact of supergun fishing on piscivorous groupers, *Cephalopholis* (Serranidae) from coral habitats in the Gulf of Aqaba. The Ecosystem of the Gulf of Aqaba in Relation to the Enhanced Economical Development and Peace Process - III, January 30- February 2, The Interuniversity Institute for Marine Sciences in Elat, Israel. p. 89.
19. **Shpigel, M.**, Neori, A. and Ben Ezra, D. (1997). The performance of an environmentally friendly polyculture system of fish, abalone and seaweed. World Aquaculture Society Meeting. February 19-22, Seattle, WA, USA. p. 328.

20. Shpigel, M. (1997). Integrated system in Israel. 4th International Marine Biotechnology Conference. Sorrento, Italy. 22-29 September. p 45.
21. Shpigel, M. Neori, A., Mercer, J., Ben Ezra, D. and Fridman, R. (1997). Sustainable abalone culture in an “environmentally clean” integrated system: from 3rd International Abalone Symposium. Monterey, CA, USA. October 26-31. p 64.
22. Shpigel, M. Neori, A and Ben Ezra, D. (1997). The sustainable integrated culture of seabream, seaweed and abalone in Israel. From the laboratory to a pilot plan. 3rd International Abalone Symposium, Monterey, CA USA. October 26-31. p. 63.
23. Shpigel, M. (1998). *Ulva lactuca* as food source for abalone in land based integrated system. J. Shellfish Res. 17(1):362-363.
24. Shpigel, M. (1998). *Ulva lactuca* as food source for abalone in land based integrated system. 18th Milford Aquaculture Seminar, February 23-25. Milford, CT, USA. p. 42.
25. Shpigel, M., Neori, A., Popper, D., Mozes, N., Zmora, O. and Gordin, H. (1998) Environmentally Clean Integrated Mariculture in Israel. World Aquaculture Society Meeting. Las Vegas, NV, USA, February 15-19. World Aquaculture Society. p. 254.
26. Shpigel, M., Neori, A., Ben-Ezra, D., Fridman, R., Krugeliak, H., Rotem, E., Marshall, A., Ragg, N. and Scharfstein, B. (1998). Sustainable mariculture in an “environmentally clean” integrated system..
27. Shpigel, M., Neori, A., Popper, D., Mozes, N., and Gordin, H. (1998). A sustainable mariculture in Israel. Aquaculture America 1999. 27-30 January, Tampa, FL, USA. 27-30 January 1999 p.172.
28. Shpigel, M., Neori, A., Popper, D., Mozes, N., and Gordin, H. (1998). Environmentally clean integrated system in Israel. Workshop at the University of Connecticut in Stamford. June 26-27. Stamford, CT, USA. p. 43. World Aquaculture Society Meeting. Las Vegas, NV, USA, February 15-19 Aquaculture '98 Book of Abstracts, p. 490.
29. Shpigel, M., Neori, A., Popper, D., Mozes, N., and Gordin, H. (1999). Sustainable integrated mariculture: World Aquaculture Society Annual International Conference, 26 April - 2 May 1999, Sydney, Australia. p. 698.
30. Shpigel, M., Lupatsch, I. Neori, A., and Ragg, N.L.C. (2000). Protein content determines the nutritional value of the seaweed *Ulva lactuca* for the abalone *Haliotis tuberculata*, *H. discuss hannai*, and *H. fulgens*. J. Shellfish Res., 19(1): 534.
31. Shpigel, M. and Neori, A. (2000). Evaluation of macroalgae, microalgae, and bivalves as biofilters in sustainable land-based mariculture systems. Aqua 2000, European Aquaculture Society, Nice, France, 2-6 May, Special
32. Shpigel, M., Neori, A. and Zmora, O. (2001). Sustainable land-based mariculture systems: A generic concept. WAS, Lake Buena Vista, Orlando, FL, USA. Aquaculture 2001 Book of Abstracts, p. 589.
33. Shpigel, M., McBride, S.C., Marciano, S. and Lupatsch, I. (2001) J. Shellfish Res., 19(1): 534. North American Echinoderm Conference (NAEC)
34. Shpigel, M., Neori, A. and Zmora, O. (2002). Sustainable Land-based Mariculture Systems: A Generic Concept. European Aquaculture Society, Trieste, Italy. Book of Abstracts, p. 478.2002
35. Shpigel, M. (2002). Integrated Mariculture Systems: An Overview. World Aquaculture Conference, Beijing, China, Book of Abstracts, p. 698.2002.

36. Shpigel, M., McBride, S., Marciano, S. and Lupatsch, I. (2003). Domestication of the European sea urchin (*Paracentrotus lividus*) in Israel. International Conference of Fisheries & Aquaculture, Puerto Varas, Chile. Book of Abstracts, p. 2003
37. Shpigel, M. and Lupatsch, I. (2006). Introduction of the European sea urchin (*Paracentrotus lividus*) in a land based integrated system in Israel. Natl. Shellfish Assoc., Program and Abstracts of the 98th Annual Meeting. Monterey, CA, USA. Book of abstract, P. 84.
38. Shpigel, M. (2006). Constructed wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product in landbased facilities. CD: Aqua 2006, World Aquaculture Society, Florence, Italy, May 9-13, 2006.
39. Shpigel, M., Marciano, S., Golombek, E., Ben-Ezra, D., Ben-Amotz, A., Lupatsch, I. and Kelly, M., (2006). Introduction of the European sea urchin (*Paracentrotus lividus*) in a land based integrated system. 12 Int. Echinoderm Conference. New Hampshire, USA, August 7-11. Book of abstracts, p. 57.
40. Shpigel, M. and Sagi, M. (2007). Constructed wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product. IMBC 2007 8th Intl. Mar. Biotechnology Conference Program & Abstracts, 11-16 March, Eilat, Israel, p. 164.
41. Shpigel, M. (2008) World Aquaculture Society meeting in Busan, South Korea in May 2008.
42. Shpigel, M. (2009) European Aquaculture Society meeting in Trondheim, Norway. August 2009.
43. Shpigel, M. (2010) Land based multi trophic vs. RAS system benefit and constrains. The Eight International Conference of Recirculating Aquaculture. August 20-22. Roanoke. Virginia.
44. Shpigel, M. (2010) Culture of the sea urchins *Paracentrotus lividus* in multi trophic integrated system. World Aquaculture Society meeting in San Diego, USA. 22-27 May 2010.
45. Shpigel, M. (2011). Land- based multi trophic system benefit and constrains. International conference on marine resources and beyond. September 5-7, Bremen, Germany.
46. Shpigel, M. (2012). 14th International Echinoderm Conference. August 20-24, Brussels, Belgium.
47. Shpigel, M. (2012). World Aquaculture Society meeting in Prague. September 1-6, Prague, Czech Republic.
48. Shpigel, M. (2013). World Aquaculture Society meeting in Nashville. Cost and benefit of Integrated Multi-Trophic Mariculture Systems: An Ecological Approach for a Sustainable Aquaculture. February 21-25, Nashville, Tennessee. USA.
49. Shpigel, M. (2016). Culture of the sea urchins *Paracentrotus lividus* in multi trophic integrated system. World Aquaculture Society meeting in Las Vegas, USA February, 22-26, 2016.
50. Shpigel, M. (2017). Land- based multi trophic system benefit and constrains. Aquaponics and Integrated Systems-Research and application. J. Blaustein Institute for Desert Research, Midreshet Ben Gurion (Sede Boker) on the 26th of April. 2017.

(c) Co-authored papers presented in conferences:

1. Fishelson, L and **Shpigel, M.** (1989). Compound territories and associated behavior of three *Cephalopholis* species sympatric in coral reefs of the Red Sea. 21st International Ethnological Conference. Utrecht, Austria, p. 17.
2. Porter, C.B, Krost, P., **Shpigel, M.** and Gordin, H. (1993). Grey mullet (*Mugil cephalus*) as a forager of organically enriched sediments beneath marine fish cages. (Poster). World Aquaculture Society Meeting. Torremolinos, Spain. p 562.
2. Neori, A., Ragg, N. and **Shpigel, M.** (1997). Increased protein content in *Ulva lactuca* significantly improves its nutritional value to the abalone *Haliotis discus hannai* and *Haliotis tuberculata*. World Aquaculture Society Meeting. Seattle, USA. p. 336.
3. Neori, A., Ragg, N., Lupatsch, I. and **Shpigel, M.** (1997). *Ulva lactuca* as a food source for juvenile abalone. 4th Intl. Marine Biotechnology Conference – Abstracts, p. 202.
4. Neori, A. and **Shpigel, M.** (1998). Macro algae treat effluents and feed invertebrates in sustainable, integrated mariculture. Aquaculture '98 Book of Abstracts, p. 385.
5. Goldberg R., Clark, P., Wikfors, G.H. and **Shpigel, M.** (1988). Performance of *Ulva rigida* as a biofilter in a flow-through mariculture system. 18th Milford Aquaculture Seminar, February 23-25. Milford, CT, USA. p 55. J. Shellfish Res. 17(1):354-355.
6. McBride, S.C., Rotem, E., Ben-Ezra, D. and **Shpigel, M.** (2000). Evaluation of seasonal bioenergetics of *Haliotis fulgens* and *Haliotis tuberculata*. J. Shellfish Res., 19(1): 525.
7. Mozes, N., Blancheton, J.P., Sadek, S., Gordin, H. and **Shpigel, M.** (2000). Overview of land based mariculture in the Mediterranean with an emphasis on the development of sustainable intensive systems. Aqua 2000, European Aquaculture Society, Nice, France, 2-6 May, 2000 Special Publication no. 28, p. 491.
7. Boarder, S.J. and **Shpigel, M.** (2000). Comparative growth performance of juvenile *Haliotis roei* fed on enriched *Ulva rigida* and various artificial diets. J. Shellfish Res., 19(1): 502.
8. Neori, A. and **Shpigel, M.** (2001). Sustainable land-based mariculture: an evaluation of algae and bivalves as biofilters in intensive fish culture. XVIIth Intl. Seaweed Symposium, Cape Town, South Africa.
9. Neori, A., **Shpigel, M.** and Sharfstein, B. (2001). Land-based low-pollution integrated mariculture: Principles of development, design, operation and economics. Aquaculture Europe 2001, Trondheim, Norway, p. 256.
10. McBride, S., **Shpigel, M.**, Lupatsch, I., Lawrence, J.M. and Lawrence, A.L. (2001).

The effect of energy and protein supply on gonad development of European sea urchins *Paracentrotus lividus* fed algal and prepared diets. WAS, Orlando, FL, USA. Aquaculture 2001 Book of Abstracts, p. 418.

11. Zmora, O. and **Shpigel, M.** (2001). Filter feeders as biofilter in marine land-based systems. WAS, Orlando, FL, USA. Aquaculture 2001 Book of Abstracts, p. 716.
12. Neori, A., **Shpigel, M.**, Odintsev, V. and Krom, M.D. (2002). Integrated and zero-effluent mariculture technologies: The future is here. Aquaculture Europe 2002, Trieste, Italy. Book of Abstracts, p. 372.
13. Schuenhoff, A., **Shpigel, M.**, Lupatsch, I. and Neori, A. (2002). A semi-recirculating integrated system for the culture of fish and seaweed. World Aquaculture Conference, Beijing, China, Book of Abstracts, p. 685.
14. Gordon, N., Neori, A., Harpaz, S. and **Shpigel, M.** (2002). Nutritional requirements of postlarvae of the Japanese abalone *Haliotis discus hanai*. Isr. J. Aquacult./Bamidgeh 54(2): 59.
15. Neori, A. and **Shpigel, M.** (2003) Mariculture sustainability by integration of algae/algivores to fish/shrimp ponds – A working technology. 1st Congress of the Intl. Soc. For Applied Phycology/9th Intl. Conf. on Applied Algology. Almeria, Spain. Book of Abstracts.
16. Neori, A., Chopin, T., Troell, M., Buschmann, A.H., Kraemer, G.P., Halling, C., **Shpigel, M.** and Yarish, C. (2003). Integrated aquaculture: rationale, evolution and state of the art, emphasizing seaweed biofiltration. European Aquaculture Society Special Publication no. 12 p. 156 .
17. Neori, A., Buschmann, A., Trolls, M., Yarish, C., **Shpigel, M.** and Chopin, T. (2004). Seaweed biofilters in modern integrated intensive mariculture – rationale, evolution and state of the art. World Aquaculture Conference, Honolulu, Hawaii, USA. Book of Abstracts, p. 992.
18. Neori, A. and **Shpigel, M.** (2004). Algae: A key for sustainable integrated mariculture: Profitable expansion of mariculture without pollution. World Aquaculture Conference, Honolulu, Hawaii, USA. Book of Abstracts, p. 836.
19. Hussenot, J., Blachier, P., Bunting, S., MacDougall, K., Husson, B., Rigby, M. Scharfstein, B. and **Shpigel, M.** (2004). First biological results and environmental evaluation of the different prototypes of marine land-based integrated aquaculture systems developed in the Genesis European project. World Aquaculture Conference, Honolulu, Hawaii, USA. Book of Abstracts, p 227.
21. Neori, A. and **Shpigel, M.** (2004). The ultimate food frontier: algal culture is key to a sustainable exploitation of the sea. Australasian Aquaculture 2004, Sydney, Australia. Book of Abstracts, p 76.

22. Volkis, B., Marciano, S., Ben-Amotz, A., and **M. Shpigel** (2005). Determination of carotenoids in gonads of sea urchins (*Paracentrotus lividus*) fed artificial and natural diets. The Israel Society for Marine and Freshwater Research. Book of Abstracts, p. 16.
22. Lupatsch, I., Golombek, E. and **Shpigel, M.** (2006). Energy and protein requirements for maintenance and growth in the sea urchin (*Paracentrotus lividus*). Natl. Shellfish Assoc., Program and Abstracts of the 98th Annual Meeting. Monterey, CA, USA
23. Anderson, M.A., Ilan, M., **Shpigel, M.** and Hill, R.T. (2007). Microbial communities of three Red Sea sponges in an open water aquaculture system. IMBC 2007 8th Intl. Mar. Biotechnology Conference Program & Abstracts, p. 157.
24. Ben-Ari, H., **Shpigel, M.**, Rosenfeld, H. (2010): The 11th Dan Popper Symposium. The symposium was organized by the National Center for Mariculture, Israel Oceanographic & Limnological Research (IOLR), together with the Society of Israeli Aquaculture and Marine Biotechnology (SIAMB) and the Agricultural Research Organization (ARO) – Ministry of Agriculture, Eilat, Israel.
25. Ben-Ari, H., Shpigel, M., Rosenfeld, H. 2010: The Israeli Association for Aquatic Sciences conference, Eilat, Israel.
26. Ben-Ari, H., Shpigel, M., Rosenfeld, H. 2011: Aquaculture Europe 2011. The symposium was organized by the European Aquaculture Society. Rhodes, Greece.
27. Shpigel, M., 2011. Sustainable Multi-trophic Mariculture Systems in the Red Sea: Back to the Future. THE DUAL TAIWAN-ISRAEL RESEARCH SYMPOSIUM ON "ARTIFICIAL INTELLIGENCE AND LEARNING ALGORITHMS" AND "EFFECTS OF HUMAN ACTIVITIES ON MARINE ENVIRONMENTS" under the auspices of The Israeli Ministry of Science and Technology and Taiwan National Science Council organized. Haifa, Israel.
28. Ben-Ari, H., **Shpigel, M.**, Rosenfeld, H. 2012: The 14th International Echinoderm Conference 2012. Brussels, Belgium.
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