

TITLE OF INVENTION: A NET CAGE, MARINE FARMING SYSTEM AND METHOD OF USE THEREOF

FIELD

[0001] The present invention relates to a net cage, marine farming system and method of use thereof. While the present invention will be described with respect to its application in the farming of fish, the present invention is not limited to this application, and the farming of other marine animals is also envisaged.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] A growing percentage of seafood sold in the market is commercially farmed rather than caught in the wild. Various marine farming systems have been developed and used to facilitate large scale commercial farming of fish and other marine animals. These marine farming systems are typically large structures incorporating a metal support structure which can be held in position by legs in a similar manner to offshore oil rigs. Alternatively, the support structures can be held in position using anchors engaging the sea floor. Ship hulls have also been used as support structures for marine farming systems. These support structures can support one or more enclosures for accommodating the fish being grown. These enclosures typically have a large frame formed by steel struts that define an enclosure space. This frame supports netting to thereby retain the fish within the cage while allowing the free flow of seawater therethrough. These marine farming systems generally need to be located close to the coast of a country to facilitate the regular supply of commercial manufactured feed to the fish being grown, as well as to provide for ongoing maintenance and monitoring of the marine farming system.

[0004] The current farming systems do however have a number of disadvantages:

- a) The support structures and enclosures are expensive to manufacture and to maintain, being continuously exposed to sea water.
- b) The large size of the support structures and cages make the farming structure difficult and costly to transport to the location where the farming system is to be installed.
- c) The cost for supplying commercially manufactured feed for feeding the fish also forms a very large percentage of the costs involved in the ongoing operational costs of the farming system;
- d) The location of the farming systems within coastal water areas can lead to the fish being exposed to any pollution of the coastal waters which will be detrimental to the health of the fish as well as leading to potential contamination of the fish being grown by the pollutants.
- e) The coastal water location of the farming system means that the farm is located within the territorial waters of a country, and therefore subject to government regulations and taxes of that country further increasing operational costs.

[0005] An object of the invention is to ameliorate one or more of the above-mentioned difficulties.

SUMMARY

[0006] According to an aspect of the present disclosure, there is provided a net cage for a marine farming system comprising: at least a first foldable float assembly; a foldable net assembly including a net, the net assembly being supported by the first float assembly when deployed within a marine environment, the net assembly when deployed providing an enclosure space therein; wherein the net cage has a compact folded configuration and an expanded deployed configuration.

In some embodiments, the net cage further comprises a second float section assembly locatable adjacent the first assembly, wherein the first and second float

assemblies are interconnected by at least one connection line to allow for relative displacement of the first and second float assemblies such that the first and second assemblies can be spaced apart when in use.

[0007] In some embodiments, the float assembly(s) comprises a plurality of interconnected float sections for allowing the displacement of the float sections between the folded and deployed configurations thereof.

[0008] In some embodiments, the float sections are inflatable to thereby control the buoyancy of the float assembly(s).

[0009] In some embodiments, the float sections of the float assembly(s) are aligned in a substantially parallel relationship with other said float sections when the net cage is in the folded configuration, with the net assembly being folded and supported on the aligned float sections.

[0010] In some embodiments, the net assembly further comprises a horizontal weighted stiffener member located at a lower portion of the net when deployed to facilitate deployment of and maintain the net cage in the deployed configuration.

[0011] In some embodiments, the net assembly further comprises at least one vertical stiffener member extending between and interconnected the first float assembly to the horizontal weighted member.

[0012] In some embodiments, the net assembly further comprises an expandable member located in an intermediation portion of the net assembly when deployed, the expandable member pressing against the net to thereby maintain the volume of the deployed net assembly and prevent the net from collapsing.

[0013] According to another aspect of the present disclosure, there is provided a marine farming system comprising; at least one net cage as described above; and a dynamic positioning (DP) vessel for towing the at least one net cage when in the folded configuration, and for maintaining the position of the at least one net cage when in the deployed position.

[0014] In some embodiments, the marine farming system comprises a plurality of net cages that are respectively towed and positioned by the DP vessel.

[0015] In some embodiments, the net cages are respectively interconnected by connection lines in a chain configuration.

[0016] In some embodiments, the DP vessel is connected to a first net cage of the chain connected net cages.

[0017] According to another aspect of the present disclosure, there is provided a method of operating a marine farming system comprising at least one net cage towable by a dynamic positioning (DP) vessel, each net cage comprising at least a first foldable float assembly; a foldable net assembly including a net, the net assembly being supported by the first float assembly when deployed within a marine environment, the net assembly when deployed providing an enclosure space therein; the net cage having a compact folded configuration and an expanded deployed configuration.

wherein the method comprises:

- a) towing the at least one net cage in the folded configuration to a selected ocean farming location;
- b) unfolding the at least one net cage to the deployed configuration when in position at the selected ocean farming location; and
- c) the DP vessel maintaining the position of at least one net cage at the selected ocean farming location.

[0018] In some embodiments, the method further comprises towing a plurality of the net cages in a chain configuration.

[0019] In some embodiments, the method further comprises accommodating fish and/or other marine animals at each said net cage at different growth stages thereof.

[0020] In some embodiments, the method further comprises selecting the ocean farming location based on water purity at the ocean farming location.

[0021] In some embodiments, the method further comprising selecting the ocean farming location based on the amount of natural feed provided at the ocean farming

location.

[0022] In some embodiments, the at least one net cage further comprises a second float section assembly locatable adjacent the first assembly, the first and second float assemblies being interconnected by at least one connection line to allow for relative displacement of the first and second float assemblies such that the first and second assemblies can be spaced apart when in use, the method further comprising separating the first and second float assemblies to thereby further submerge the associated net assembly during poor weather conditions.

[0023] In some embodiments, the first and second assemblies comprising inflatable float sections, wherein the net assembly is lowered by inflating the float sections of the second float assembly and deflating the float sections of the first float assembly.

[0024] Other aspects and features will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] In the figures, which illustrate, by way of example only, embodiments of the present invention,

[0026] [Figures 1a and 1 b] are plan and elevation views respectively of a marine farming system according to the present disclosure;

[0027] [Figure 2] is a plan view of a deployed net cage according to the present disclosure;

[0028] [Figures 3a and 3b] are elevation views of the net cage of [figure 2] respectively shown in a normal operating position and a submerged operating position;

[0029] [Figures 4a and 4b] are a plan view and cross-sectional view respectively of the net trap of [figure 2] when in a folded configuration;

[0030] [Figures 5a and 5b] are plan and elevation views respectively of the marine farming system with the net cages in the folded configuration as shown in [figure 4a and 4b]; and

[0031] [Figure 6] is an elevational view of another embodiment of a net cage when deployed according to the present disclosure.

[0032] Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

DETAILED DESCRIPTION

[0033] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0034] Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0035] Example embodiments of the present invention will now be described with reference to the accompanying drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present invention. Other definitions for selected terms used herein may be found within the detailed description of the invention and apply throughout the description. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs. Where possible, the same reference numerals are used throughout the figures for clarity and consistency.

[0036] It would be advantageous to be able to conduct fish farming in the international waters away from coastal water areas. The water is more likely to be free of pollution in the open ocean unlike coastal water areas adjacent country coastlines. Furthermore, feed costs can be reduced or eliminated if the farming is conducted in areas having a natural feed source for the fish. For example, it would be advantageous to farm in locations populated with krill, which can then provide a natural feed source for the fish. Furthermore, the location of the farming system in international waters eliminates the need to comply with the regulations and taxes that can be imposed by any country on farming systems located within their territorial waters.

[0037] It would also be advantageous to have a marine farming system that can be readily moved to different areas. As well as allowing the farming system to be moved to areas of the free ocean with unpolluted waters and a source of natural feed, it also enable the marine farming system to be moved where necessary to avoid any extreme weather conditions such as storms that may arise.

[0038] In [Figs. 1a and 1b], there is shown the main components of the marine farming system 1 according to the present disclosure that can achieve the abovenoted advantages. The marine farming system 1 comprises at least one foldable net cage 3 which can be towed and positioned by a dynamic positioning (DP) vessel 5. [Figs. 1a and 1b] show four of these foldable net cages 3 interconnected by connection lines 7 in a chain configuration. The chain of net cages 3 can be towed at one end thereof by a single DP vessel 5 that is connected via a tow line 9. It is to be appreciated that the number of net cages 3 used in the marine farming system 1 can vary as required, and the marine farming system 1 according to the present disclosure is therefore not restricted to the specific configuration shown in [figs. 1a and 1b].

[0039] [Figs. 2 to 3b] show in more detail the net cage 3 according to the present disclosure. The net cage 3 is shown in a deployed configuration once located within a marine environment. Each net cage 3 comprises a first foldable float assembly 11, and a second float assembly 15 located over and connected via connection lines 25 to the first float assembly 11. The first float assembly 11 supports a foldable net

assembly 17 including a net 19 that defines an enclosed space for accommodating the fish being grown when in the deployed configuration. The net cages 3 as shown has a generally hexahedron shape with the net 19 extending over each of the six sides of the net assembly 17. The net assembly 17 is not however restricted to this shape, and it is also envisaged that the net assembly 17 be of an alternative shape. The net assembly 17 could for example alternatively be cylindrical in shape. The net assembly 17 further comprises a horizontal weighted stiffener member 23 located at a lower portion of the deployed net 19 which assists in facilitating the deployment of the net assembly 17. One or more vertical stiffener member 21 may also be provided in the net assembly 17, with the or each vertical stiffener member 21 extending between and interconnecting the first float assembly 11 to the horizontal weighted stiffener member 23. The net assembly 17 is supported by the first float assembly 11 when the net cage 3 is located at a selected farming location within marine environment.

[0040] The second float assembly 15 is located over the first float assembly 11 once the net cage 3 has been deployed. The second float assembly 15 is shown in plan view in [fig. 2] which shows the second float assembly 15 comprises several float sections 15a,15b,15c,15d interconnected by foldable connections 16a,16b,16c,16d. Each float section 15a,15b,15c,15d is inflatable to thereby control the buoyancy of the second float assembly 15. The first float assembly 11 may have the same or similar configuration to the second float assembly 15 and may also comprises several inflatable float sections 11a interconnected by foldable connections (not shown).

[0041] The marine farming system 1 according to the present disclosure allows the net cages 3 to be repositioned to another location as necessary to avoid poor weather conditions such as storms. Alternatively, or in addition, the net cages 3 can be reconfigured to accommodate these poor weather conditions. [Fig. 3a] shows the net cage 3 under normal operating conditions with the first float assembly 11 inflated and the second float assembly 15 deflated. This allows the top of the net assembly 17 to be located close to the waterline at the ocean farming location. However, during poor weather conditions, the net assembly 17 can be further submerged into a submerged operation position as shown in [fig. 3b] to thereby avoid or minimise any

damage to the net assembly that may occur through exposure to the poor weather conditions. This is achieved by inflating the second float assembly 15 and deflating the first float assembly 11. This results in the net assembly 17 sinking further below the waterline, preferably by several metres, with the second float assembly 15 supporting the submerged net assembly 17 via connection lines 25 connecting the inflated second float assembly 15 to the deflated first assembly 11 which submerges together with the net assembly 17.

[0042] [Figs 4a and 4b] show the net cages 3 when in the folded configuration. The float assemblies 11,15 of each net cage can be folded to form a relatively narrow platform upon which can be supported the folded net assembly 17. This facilitates the transport of the net cages 3 to the selected farming location as the net cages 3, once folded, are easier to tow and therefore transport using the DP vessel 5 as shown in [figs. 5a and 5b], or by any other suitable vessel. It is also envisaged that the folded net cages 3 can be transported by more conventional means such within a cargo ship. The compact size of the folded net cages 3 can allow them to be readily accommodated within the cargo hull.

[0043] [Fig. 6] shows another embodiment of a net cage 3A according to the present disclosure. This embodiment of the net cage 3A shares the same features as the net cage shown in [figs. 1 to 5b] including a first float assembly 11, second float assembly 15 and a net assembly 17A supported by the first float assembly 11 when in the normal operating position as shown in [fig. 6]. The net assembly 17A is also provided with a net 19, horizontal weighted stiffener member 23 and vertical stiffener member(s) 21. The net assembly 17A however differs from the previously described embodiments of the net cage 3 in having a further expandable member 25 which can be installed, for example in a generally intermediate portion of the net assembly 3A as shown in [fig. 6]. The expandable member 25 may be in the form of a pressure pipe which can be expanded, for example inflated, to press against the net 19 to thereby maintain the volume of the deployed net assembly 17A and prevent the net 19 from collapsing.

[0044] The marine farming system 1 according to the present disclosure can be used in the following manner:

- a) A suitable ocean farming location is selected, preferably within international waters, based on the water purity and the amount of natural feed at that location;
- b) The net cages 3, when in the folded configuration, can then be towed by the DP vessel 5 or other vessel to the selected ocean farming location;
- c) The net cages 3 can then be unfolded into the deployed configuration when the selected ocean farming location for the marine farming system is reached;
- d) The DP vessel will then continue to operate to maintain the position of the net cages 3 at the selected ocean farming location to thereby prevent any drift of the net cages 3 therefrom; and
- e) The DP vessel can also tow the net cages 3 to another location to avoid any poor weather conditions if desired.

[0045] In order to facilitate the growth and harvesting of the fish, fish at different growth stages can be accommodated in different net cages 3. For example, the net cages closer to the DP vessel can accommodate fish at later growth stages, with the fish at earlier growth stages being accommodated further from the DP vessel.

[0046] It should be appreciated by the person skilled in the art that the above invention is not limited to the embodiment described. It is to be appreciated that modifications and improvements may be made without departing from the scope of the present invention.

[0047] It should be further appreciated by the person skilled in the art that one or more of the above modifications or improvements, not being mutually exclusive, may be further combined to form yet further embodiments of the present invention.

CLAIMS

[Claim 1] A net cage for a marine farming system comprising:

at least a first foldable float assembly;

a foldable net assembly including a net, the net assembly being supported by the first float assembly when deployed within a marine environment, the net assembly when deployed providing an enclosure space therein;

wherein the net cage has a compact folded configuration and an expanded deployed configuration.

[Claim 2] A net cage according to claim 1, further comprising a second float section assembly locatable adjacent the first assembly, wherein the first and second float assemblies are interconnected by at least one connection line to allow for relative displacement of the first and second float assemblies such that the first and second assemblies can be spaced apart when in use.

[Claim 3] A net cage according to claim 1 or 2, wherein the float assembly(s) comprises a plurality of interconnected float sections for allowing the displacement of the float sections between the folded and deployed configurations thereof.

[Claim 4] A net cage according to claim 3, wherein the float sections are inflatable to thereby control the buoyancy of the float assembly(s).

[Claim 5] A net cage according to claim 3 or 4, wherein the float sections of the float assembly(s) are aligned in a substantially parallel relationship with other said float sections when the net cage is in the folded configuration, with the net assembly being folded and supported on the aligned float sections.

[Claim 6] A net cage according to any one of the claims, the net assembly further comprising a horizontal weighted stiffener member located at a lower portion of the net when deployed to facilitate deployment of and maintain the net cage in the deployed configuration.

[Claim 7] A net cage according to claim 6, the net assembly further comprising at least

one vertical stiffener member extending between and interconnected the first float assembly to the horizontal weighted member.

[Claim 8] A net cage according to any one of the preceding claims, the net assembly further comprising an expandable member located in an intermediation portion of the net assembly when deployed, the expandable member pressing against the net to thereby maintain the volume of the deployed net assembly and prevent the net from collapsing.

[Claim 9] A marine farming system comprising;

at least one net cage as claimed in any one of the preceding claims; and

a dynamic positioning (DP) vessel for towing the at least one net cage when in the folded configuration, and for maintaining the position of the at least one net cage when in the deployed position.

[Claim 10] A marine farming system according to claim 9 comprising a plurality of net cages that are respectively towed and positioned by the DP vessel.

[Claim 11] A marine farming system according to claim 10, wherein the net cages are respectively interconnected by connection lines in a chain configuration.

[Claim 12] A marine farming system according to claim 11, wherein the DP vessel is connected to a first net cage of the chain connected net cages.

[Claim 13] A method of operating a marine farming system comprising at least one net cage towable by a dynamic positioning (DP) vessel, each net cage comprising at least a first foldable float assembly; a foldable net assembly including a net, the net assembly being supported by the first float assembly when deployed within a marine environment, the net assembly when deployed providing an enclosure space therein; the net cage having a compact folded configuration and an expanded deployed configuration.

wherein the method comprises:

d) towing the at least one net cage in the folded configuration to a selected ocean

farming location;

- e) unfolding the at least one net cage to the deployed configuration when in position at the selected ocean farming location; and
- f) the DP vessel maintaining the position of at least one net cage at the selected ocean farming location.

[Claim 14] A method according to claim 13, the method further comprising towing a plurality of the net cages in a chain configuration.

[Claim 15] A method according to claim 14, the method further comprising accommodating fish and/or other marine animals at each said net cage at different growth stages thereof.

[Claim 16] A method according to any one of claims 13 to 15, the method further comprising selecting the ocean farming location based on water purity at the ocean farming location.

[Claim 17] A method according to any one of claims 13 to 16, the method further comprising selecting the ocean farming location based on the amount of natural feed provided at the ocean farming location.

[Claim 18] A method according to any one of claims 13 to 16, the at least one net cage further comprising a second float section assembly locatable adjacent the first assembly, the first and second float assemblies being interconnected by at least one connection line to allow for relative displacement of the first and second float assemblies such that the first and second assemblies can be spaced apart when in use, the method further comprising separating the first and second float assemblies to thereby further submerge the associated net assembly during poor weather conditions.

[Claim 19] A method according to claim 18, the first and second assemblies comprising inflatable float sections, wherein the net assembly is lowered by inflating the float sections of the second float assembly and deflating the float sections of the first float assembly.