CLAIMS

1. A method of collecting and separating floating debris and water from a body of water on a vessel moveable in the body of water, the vessel including at least one inflow regulator (IFR) chamber distinct from a main collection compartment and fluidly coupled thereto by at least one passageway, at least one intake opening fluidly coupling the at least one IFR chamber and the body of water and through which water and floating debris can enter the at least one IFR chamber and vessel from the body of water, at least one water removal outlet and at least one debris removal outlet, distinct from the water removal outlet(s), fluidly coupled to the main collection compartment, the main collection compartment having a length, width, height and upper and lower ends, the at least one passageway and the at least one water removal outlet fluidly coupled to the main collection compartment closer to the lower end than the upper end of the main collection compartment and the at least one debris removal outlet fluidly coupled to the main collection compartment closer to the upper end than the lower end of the main collection compartment, the method comprising:

filling the main collection compartment with liquid to a fill height above the at least one passageway and at least one water removal outlet; and

after filling the main collection compartment with liquid to the fill height, concurrently

drawing floating debris and water from the at least one IFR chamber through the at least one submersed passageway and into the main collection compartment during collection operations,

at least one IFR at least partially floating in the at least one IFR chamber and reducing wave action and/or turbulence in the floating debris and water passing through the at least one IFR chamber to the main collection compartment during collection operations,

allowing floating debris in the main collection compartment to rise above the at least one debris removal outlet and water in the main collection compartment,

removing water from the main collection compartment through the at least one water removal outlet, and

allowing floating debris to be removed from the main collection compartment through the at least one debris removal outlet and directed to one or more debris delivery destinations.

2. The method of claim 1 further including minimizing emulsification of water and debris in the main collection compartment during collection and separation operations.

3. The method of claim 1 further including creating a vacuum above the surface of the contents of the main collection compartment.

4. The method of claim 1 further including, at least initially, filling the main collection compartment with primarily water from the body of water to a fill height above the at least one debris removal outlet and evacuating all or substantially all air from the main collection compartment above the surface of the contents therein.

5. The method of claim 4 further including

initially completely filling the main collection compartment with primarily water from the body of water and, thereafter, maintaining the main collection compartment completely full of water and/or debris during collection operations, and/or

causing floating debris and little or no water to enter the main collection compartment during collection operations.

6. The method of claim 1 wherein the vessel includes at least one trunk having at least one upwardly extending void fluidly coupled to the main collection compartment at or above the upper end thereof, the at least one void having a width that is smaller than the length and width of the main collection compartment, further including allowing water and/or floating debris to completely fill the main collection compartment and extend up into at least one void of at least one trunk during collection operations.

7. The method of claim 6 wherein the at least one debris removal outlet is fluidly coupled to the at least one void, further including allowing floating debris to float to the upper end of the main collection compartment and into the at least one trunk and be removed therefrom through the at least one debris removal outlet and directed to one or more debris delivery destinations.

8. The method of claim 7 further including at least substantially preventing the entry of air into the main collection compartment during collection and separation operations.

9. The method of claim 1 further including ceasing drawing floating debris and water from the at least one IFR chamber into the main collection compartment and allowing at least one IFR to extend at least partially above the surface of the contents of the at least one IFR chamber and prevent floating debris from backing out of the at least one IFR chamber through the at least one intake opening to the body of water.

10. The method of claim 1 wherein at least one IFR is disposed on the vessel at a height above the location of the at least one passageway, further including the at least one IFR limiting the floating debris and water that enters the main collection compartment during collection operations to primarily floating debris and water that passes over the at least one IFR.

11. The method of claim 10 wherein the at least one passageway has a width or diameter that is less than 10 percent the height of the main collection compartment and is disposed at or proximate to the bottom of the main collection compartment, further including drawing primarily floating debris over the at least one IFR, down in the at least one IFR chamber, through the at least one passageway and into the main collection compartment during collection operations.

12. The method of claim 1 wherein a second IFR is disposed in the at least one IFR chamber between a first IFR and the main collection compartment, further including the first IFR primarily reducing wave action and/or turbulence in the water and floating debris moving through the at least one IFR chamber and the second IFR primarily causing mostly floating debris to enter the main collection compartment during collection operations.

13. The method of claim 1 wherein at least one IFR is a variable buoyancy IFR, further including selectively actuating at least one variable buoyancy IFR during collection operations to vary the buoyancy thereof and its ability to reduce turbulence in the floating debris and water moving through the at least one IFR chamber and into the main collection compartment.

14. The method of claim 13 further including selectively actuating at least one variable buoyancy IFR during collection operations to vary the buoyancy thereof and its ability to cause mostly floating debris to enter the main collection compartment during collection operations.

15. The method of claim 1 wherein a second IFR is disposed in the at least one IFR chamber between a first IFR and the main collection compartment, both IFRs being variable buoyancy IFRs, further including selectively actuating the second IFR during collection operations to de-ballast it higher in the at least one IFR chamber than the first IFR when the floating debris on the surface of the body of water is a sheen and/or decreases in thickness proximate to the at least one intake opening to assist in increasing the volume and cascading movement of floating debris passing by the second IFR into the main collection compartment.

16. The method of claim 1 wherein a second IFR is disposed in the at least one IFR chamber between a first IFR and the main collection compartment, both IFRs being variable buoyancy IFRs, further including selectively actuating the first IFR to de-ballast it higher in the at least one IFR chamber than the second IFR during collection operations when there is an increase in at least one among the speed of the vessel in the body of water and/or the water turbulence and/or wave action in the body of water proximate to the at least one intake opening.

17. The method of claim 1 further including at least one fluid discharge pump drawing water and floating debris from the at least one IFR chamber, through the at least one passageway and into main collection compartment.

18. The method of claim 17 further including the at least one fluid discharge pump

concurrently (i) drawing water and floating debris from the body of water into the at least one IFR chamber and main collection compartment and (ii) removing water and little or no debris from the main collection compartment through the at least one water removal outlet and discharging it to the body of water during collection and separation operations.

19. The method of claim 17 further including the at least one fluid discharge pump lowering the liquid level in the at least one IFR chamber between the at least one passageway and the at least one IFR lower than the liquid level in the at least one IFR chamber between the IFR(s) and the intake opening(s) of the vessel to assist in increasing at least one among the cascading movement, volume and rate of floating debris drawn over the at least one IFR and into the main collection compartment.

20. The method of claim 17 further including at least one debris discharge pump distinct from the at least one fluid discharge pump removing floating debris and little or no water from the main collection compartment through the at least one debris removal outlet and directing it to one or more debris delivery destinations.

21. The method of claim 20 further including the at least one debris discharge pump removing floating debris and little or no water from the main collection compartment through the at least one debris removal outlet and directing it to one or more debris delivery destinations concurrently with the at least one fluid discharge pump concurrently (i) drawing water and floating debris from the body of water into the at least one IFR chamber and main collection compartment and (ii) removing water and little or no floating debris from the main collection compartment through the

at least one water removal outlet and discharging it to the body of water during collection and separation operations regardless of whether the vessel is moving.

22. The method of claim 17 wherein at least one IFR is a variable buoyancy IFR, further including at least one among (i) selectively varying the speed of the vessel in the body of water, (ii) selectively actuating the at least one fluid discharge pump and (iii) selectively actuating at least one variable buoyancy IFR in order to assist in (a) varying the buoyancy of at least one IFR in real-time on an ongoing basis as needed during collection operations in response to one or more changes in wind, rain, wave action, turbulence or other sea conditions in or above the body of water, the type, density and/or viscosity of liquid in the body of water or main collection compartment, the thickness, size, composition and/or depth of floating debris in the body of water or main collection compartment, or a combination thereof, (b) changing at least one among the volume, rate and ratio of floating debris and water entering the main collection compartment, (c) optimizing the intake resistance of at least one IFR, (d) optimizing the efficiency and effectiveness of debris collection, (e) enhancing the separation of floating debris and water on the vessel, or a combination thereof.

23. The method of claim 22 further including

at least one debris discharge pump, distinct from the at least one fluid discharge pump, removing floating debris and little or no water from the main collection compartment through the at least one debris removal outlet and directing it to one or more debris delivery destinations during collection and separation operations, and

selectively actuating the at least one debris pump to vary the volume of floating debris removed from the main collection compartment.

24. The method of claim 17 further including increasing the suction of the at least one fluid discharge pump and/or speed of the vessel in the body of water during collection operations when the floating debris on the surface of the body of water is thicker than a sheen and/or increases in thickness proximate to the at least one intake opening in order to assist in increasing the volume and/or rate of floating debris entering the main collection compartment.

25. The method of claim 17 further including de-ballasting at least one IFR during collection operations when there is an increase in at least one among the (i) speed of the vessel in the body of water, (ii) suction of the at least one fluid discharge pump and (iii) wave action and/or turbulence in the body of water proximate to the at least one intake opening.

26. The method of claim 17 wherein the at least one IFR includes at least one buoyant portion that free-floats at or near the surface of liquid in the at least one IFR chamber, further including lowering the at least one buoyant portion of at least one IFR relative to the surface of liquid in the at least one IFR chamber during collection operations when (i) the vessel is not moving or slowed, (ii) there is a reduction in, or little or no, wave action and/or water turbulence in the body of water, (iii) the floating debris on the surface of the body of water is thicker than a sheen and/or increases in thickness proximate to the at least one intake opening, or a combination thereof.

27. The method of claim 26 further including varying the suction of the at least one fluid discharge pump and/or height of the at least one buoyant portion of at least one IFR in the at least one IFR chamber during collection operations to assist in (i) increasing the ratio of floating debris to water entering the main collection compartment, (ii) increasing the volume and cascading movement of floating debris passing by the at least one IFR into the main collection compartment,

(iii) optimizing the intake resistance of at least one IFR, (iv) optimizing the efficiency and effectiveness of debris collection, (v) enhancing the separation of floating debris and water on the vessel, or a combination thereof.

28. The method of claim 26 further including increasing the height of the at least one buoyant portion of at least one IFR in the at least one IFR chamber during collection operations when (i) the speed of the vessel in the body of water and/or the water turbulence and/or wave action in the body of water proximate to the at least one intake opening increases and/or (ii) the floating debris on the surface of the body of water is a sheen and/or decreases in thickness proximate to the at least one intake opening.

29. The method of claim 17 wherein when the vessel is moving in the body of water during collection operations, further including increasing the suction of at least one fluid discharge pump to a volume that is at least slightly greater than the volume of water and/or floating debris entering the at least one intake opening to reduce or eliminate the existence or effect of head waves at the at least one intake opening.

30. The method of claim 17 wherein the at least one fluid discharge pump is disposed in at least one suction chamber that is distinct from the at least one IFR chamber and the main collection compartment and fluidly coupled to the main collection compartment by the at least one water removal outlet, further wherein at least one suction chamber vent is fluidly coupled to the at least one suction chamber proximate to the upper end thereof, further including opening the at least one suction chamber vent during initial filling of the main collection compartment with liquid to at least partially vent the at least one suction chamber of gases and allow liquid to enter the at least

one suction chamber sufficient to submerse the at least one water removal outlet in liquid and provide a liquid-based seal between the at least one suction chamber and main collection compartment to allow minimal or no gases to enter the main collection compartment from the at least one suction chamber.

31. The method of claim 1 wherein a second IFR is disposed in the at least one IFR chamber between a first IFR and the main collection compartment, both IFRs being variable buoyancy IFRs, further including selectively actuating the second IFR to ballast it lower in the at least one IFR chamber than the first IFR during collection operations when the floating debris on the surface of the body of water is thicker than a sheen or increases in thickness proximate to the at least one intake opening.

32. A system for collecting and separating floating debris and water from a body of water on a vessel moveable in the body of water, the system comprising:

a main collection compartment disposed on the vessel and having a length, width, height and upper and lower ends;

at least one water removal outlet fluidly coupled to the main collection compartment closer to the lower end than the upper end of the main collection compartment;

at least one debris removal outlet distinct from the water removal outlet(s) and fluidly coupled to the main collection compartment closer to the upper end than the lower end of the main collection compartment;

at least one inflow regulator (IFR) chamber disposed on the vessel and at least partially separated from the main collection compartment and fluidly coupled thereto by at least one passageway, the at least one passageway being disposed closer to the lower end than the upper end

of the main collection compartment;

at least one intake opening fluidly coupling the at least one IFR chamber and the body of water, whereby water and floating debris can enter the vessel from the body of water through the at least one intake opening and into the at least one IFR chamber;

at least one fluid discharge pump fluidly coupled to the main collection compartment by the at least one water removal outlet, the at least one fluid discharge pump being selectively controllable during collection operations to draw water and floating debris from the at least one IFR chamber, through the at least one passageway and into the main collection compartment and vary at least one among the volume, rate and ratio of water and floating debris drawn into the main collection compartment; and

at least first and second IFRs at least partially floating in the same IFR chamber, the second IFR being disposed between the first IFR and the main collection compartment.

33. The system of claim 32 wherein at least one IFR is a variable buoyancy IFR that is selectively controllable during collection operations to vary the buoyancy thereof in the at least one IFR chamber.

34. The system of claim 33 further including a variable buoyancy system associated with the at least one variable buoyancy IFR, the variable buoyancy system being selectively controllable during debris collection operations to (i) allow air to escape from the at least one variable buoyancy IFR and be replaced with liquid to decrease the buoyancy thereof and (ii) provide air into the at least one variable buoyancy IFR and force liquid out of the at least one variable buoyancy IFR to increase the buoyancy thereof.

35. The system of claim 33 wherein the first and second IFRs are pivoting-type, variable buoyancy IFRs, each being disposed on the vessel at a height above the location of the at least one passageway, further wherein at least one IFR is selectively controlled to principally limit the floating debris and water that enters the main collection compartment from the at least one IFR chamber to primarily floating debris and water that passes over the at least one IFR and thereafter moves down in the at least one IFR chamber and into the at least one passageway.

36. The system of claim 32 wherein the at least one passageway has a width or diameter that is less than 10 percent the height of the main collection compartment and is disposed at or proximate to the bottom of the main collection compartment and, during collection operations, the at least one passageway and the at least one water removal outlet are submersed in liquid to provide a liquid-based seal of the main collection compartment below the surface of the contents thereof.

37. The system of claim 32 further including at least one trunk having at least one upwardly extending void fluidly coupled to the main collection compartment at or above the upper end thereof, the at least one void having a width that is smaller than the length and width of the main collection compartment, wherein the at least one debris removal outlet is fluidly coupled to the at least one void, whereby the main collection compartment may be completely filled with water and/or floating debris, and during debris collection operations, floating debris at the upper end of the main collection compartment can pass into the at least one trunk and be thereafter removed through the at least one debris removal outlet.

38. The system of claim 32 further including at least one debris discharge pump that is distinct from the at least one fluid discharge pump and fluidly coupled between the at least one debris

removal outlet and one or more debris delivery destinations, the at least one debris discharge pump being selectively controllable during collection and separation operations to vary the volume of floating debris removed from the main collection compartment through the at least one debris removal outlet.

39. The system of claim 32 wherein the at least one fluid discharge pump is disposed on the vessel in at least one suction chamber that is distinct from the at least one IFR chamber and the main collection compartment and fluidly coupled to the main collection compartment by the at least one water removal outlet, the at least one water removal outlet being disposed proximate to the lower end of the main collection compartment and submersed in water during collection operations.

40. The system of claim 32 further including at least one among:

at least one gate associated with the at least one passageway and/or the at least one water removal outlet and selectively controlled to block the at least one passageway and/or the at least one water removal outlet to fluidly isolate the main collection compartment therefrom,

at least one IFR chamber cover extending at least partially over the at least one IFR chamber on the vessel and being at least partially transparent, see-through or perforated and/or strong enough to support large-sized debris placed thereupon,

at least one front door disposed on the vessel and being selectively controllable to close off or block the at least one intake opening, and/ or

at least one large-sized debris guard on the vessel proximate to the at least one intake opening to assist in preventing large-sized debris from entering into the at least one IFR chamber.

41. The system of claim 32 wherein the first and second IFRs are variable buoyancy IFRs, wherein the first IFR is selectively controlled to principally reduce turbulence in floating debris and water passing through the at least one IFR chamber to the main collection compartment during collection operations and the second IFR is selectively controlled to principally cause mostly floating debris and little or no water to enter the main collection compartment from the at least one IFR chamber during collection operations.

42. A system for collecting and separating floating debris and water from a body of water on a vessel moveable in the body of water, the system comprising:

a main collection compartment disposed on the vessel and having a length, width, height and upper and lower ends;

at least one inflow regulator (IFR) chamber disposed on the vessel, being distinct from the main collection compartment and fluidly coupled thereto by at least one passageway;

at least one intake opening fluidly coupling the at least one IFR chamber and the body of water, whereby water and floating debris can enter the vessel from the body of water through the at least one intake opening and into the at least one IFR chamber;

at least one fluid discharge pump disposed on the vessel and fluidly coupled to the main collection compartment, the at least one fluid discharge pump being selectively controllable during collection operations to draw floating debris and water from the at least one IFR chamber through the at least one passageway and into the main collection compartment;

at least one trunk having at least one upwardly extending void fluidly coupled to the main collection compartment at or above the upper end thereof, whereby during debris collection operations, floating debris at the upper end of the main collection compartment can pass into the

at least one trunk to allow the main collection compartment to be completely filled with water and/or floating debris;

at least one debris removal outlet through which floating debris can be removed from the main collection compartment, the at least one debris removal outlet being fluidly coupled to the at least one trunk, whereby floating debris at the upper end of the main collection compartment will pass at least partially through the at least one trunk as it is removed through the at least one debris removal outlet; and

at least one IFR at least partially floating in the at least one IFR chamber.

43. The system of claim 42 further including at least one wave diminishing surface disposed on the vessel between the at least one IFR and the body of water, the at least one wave diminishing surface slanting downwardly away from the vessel and towards the body of water to assist in dampening or reducing at least one among the impact, size and/or action of waves and/or turbulence of water and/or debris entering the at least one intake opening.

44. The system of claim 42 wherein the at least one fluid discharge pump is disposed on the vessel in at least one suction chamber having upper and lower ends and being distinct from the main collection compartment and the at least one IFR chamber, the at least one suction chamber being fluidly coupled to the main collection compartment by at least one water removal outlet, the at least one water removal outlet being submersed in water during collection operations.

45. The system of claim 44 further including at least one among:

at least one suction chamber vent disposed proximate to the upper end of the at least one suction chamber to allow the at least one suction chamber to be selectively at least partially vented of gases,

at least one flooding port fluidly coupled between the main collection compartment and the body of water to allow the main collection compartment to be at least partially filled with liquid from the body of water, and/or

at least one air discharge vent disposed at or proximate to the upper end of, and fluidly coupled to, the main collection compartment to allow the main collection compartment to be selectively at least partially vented of gases.

46. The system of claim 45 wherein when the system includes at least one flooding port, further including at least one submersible fluid pump fluidly coupled to at least one flooding port and being selectively actuated to completely fill the main collection compartment with liquid from the body of water and/or when the system includes at least one air discharge vent, at least one vacuum pump fluidly coupled to the at least one air discharge vent and selectively controllable to remove gases from the main collection compartment.

47. The system of claim 42 further including at least one sensor disposed at least partially within the main collection compartment to indicate whether debris is at a particular height in the main collection compartment.

48. The system of claim 47 further including at least a first sensor disposed inside the main collection compartment above the at least one passageway and the at least one water removal outlet

to indicate when debris should be removed from the main collection compartment through the at least one debris removal outlet and assist in avoiding more than minimal debris being sucked into the at least one fluid discharge pump, and at least a second sensor disposed on the vessel below the at least one debris removal outlet to indicate when debris should not be removed from the main collection compartment through the at least one debris removal outlet and assist in avoiding more than minimal water being removed from the main collection compartment through the at least one debris removal outlet.