

Complete Station List of the R/V *Te Vega* as part of the U.S. Program in Biology, International Indian Ocean Expedition and Description of Sampling Equipment 10 April 2019 Version

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The International Indian Ocean Expedition (IIOE) was a multinational oceanographic program planned by the Scientific Committee on Oceanic Research (SCOR) starting in 1957 and later (1961) co-sponsored by the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The IIOE started in late 1959 and ended in 1965.

The United States was one of the major contributors to the IIOE, and one of the largest of the U.S. activities was the U.S. Program in Biology. This program included cruises of two vessels, the R.V. *Anton Bruun* and R/V *Te Vega*, activities at two land-based camps, and a variety of independent investigations. These activities were funded primarily by the U.S. National Science Foundation and the outcomes of the U.S. Program in Biology will be described in a later publication. A list of stations occupied by the *Anton Bruun* is available at <http://dspace.udel.edu/handle/19716/24076>.

The R/V *Te Vega* was a sailing vessel owned by Stanford University and used for training of marine biology graduate students. The *Te Vega* conducted four cruises in the Indian Ocean (Table 1). Participants in Cruise 5 published a reflection on the cruise and the significant benefits of this kind of field program (Pearse et al., 2016).

Table 1. Cruises of the R/V *Te Vega* as part of the U.S. Program in Biology (see <https://scor-int.org/project/iioe-1/>).

Dates	Cruise Identifier	Chief Scientist	Location
10 Oct. 1963-1 Feb. 1964	Cruise A/Cruise 2	Rolf Bolin	Singapore/Malaysia to Colombo, Ceylon (Sri Lanka)
1 Feb.-5 June 1964	Cruise B/Cruise 3	Dixie Lee Ray	Colombo, Ceylon (Sri Lanka) to Tamatave, Madagascar
21 July-28 Sept. 1964	Cruise C/Cruise 4	Rolf Bolin	Majunga, Madagascar to Mombasa, Kenya
20 Oct. 1964-22 Jan. 1965	Cruise 5	Donald P. Abbott	Seychelles Islands to Singapore/Malaysia

The purpose of this document is to provide the first complete list of the stations occupied by the *Te Vega* during the IIOE, about 175 stations in all (Figure 1). This information was compiled from the cruise reports from each cruise (Appendix 1; see cruise tracks and sampling stations in Figures 2-5) and the list of specimens submitted to the Smithsonian Institution from cruises of

the *Te Vega* (Appendix 2). The *Te Vega* did not take samples with the Indian Ocean Standard Net.

The compiled list of data from these sources is available at <http://udspace.udel.edu/handle/19716/24094> in Microsoft Excel and pdf formats. The following information is provided in these files:

- Cruise Number. There were four cruises of the R/V *Te Vega* as part of the IIOE-2 (see Table 1 earlier). Three of the cruises also have a letter designation.
- Station Number: The same stations are not always shown in the cruise reports and the Smithsonian records, but the Excel file combines data from both sources. This provides a cross-reference among the two data sources. Some stations are given in the Smithsonian records that are not found in the cruise reports; some stations have multiple designators. Some scientists assigned their own station numbers.
- Longitude and latitude: The values given in the cruise reports were converted to decimal degrees from a standard degrees/minutes format. In cases for which the cruise reports differed from the data in the Smithsonian records, the cruise report coordinates were used.
- Local date that the station was occupied.
- The biogeographic province of the station, based on the provinces proposed by Costello et al. (2017). These provinces were formed according to statistical methods based on cluster analysis techniques on data contained in the Ocean Biogeographic Information System (OBIS).
- Sampling methods/equipment at the station. A description of sampling equipment can be found in Appendix 3. This information is primarily from the cruise reports, although some sampling equipment information is given in the Smithsonian records.
- Reference(s) for the station information. Most of the information is from the cruise reports, although this information is augmented for some stations for which samples were submitted to the Smithsonian Institution.
- Discrepancies of cruise reports with other data sources. In cases for which the data in the Smithsonian or other data sources differ from data in the cruise reports, the cruise report data are given and the source(s) of the variant data are also noted.

This document will be updated in the future if corrections or additions need to be made. Any changes needed should be transmitted to Ed Urban at [edward.r.urban\[at\]gmail.com](mailto:edward.r.urban@gmail.com).

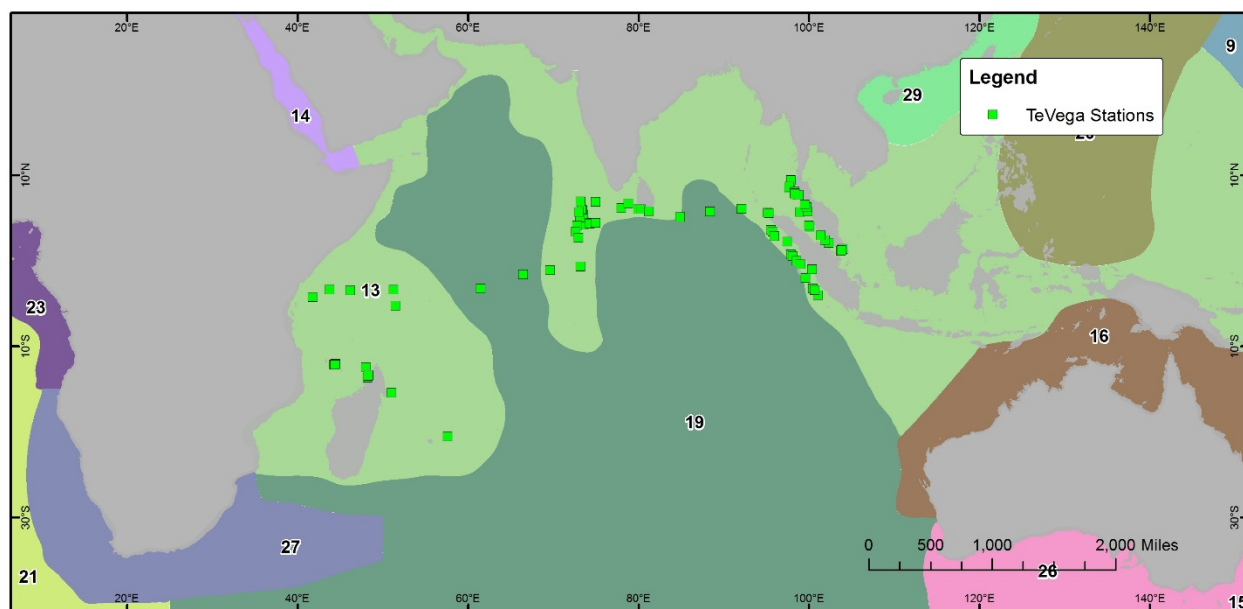


Figure 1. Stations occupied by the R/V *Te Vega* as part of the U.S. Program in Biology of the International Indian Ocean Expedition. The stations are overlaid by a map of the numbered biogeographical provinces described in Costello et al. (2017). Figure created by Zeenatul Basher.

Acknowledgements

Zeenatul Basher assigned Costello et al. (2017) provinces to each station and plotted the data in Figure 1.

References

- Bradbury, M.G., D.P. Abbott, R.V. Bovbjerg, R.N. Mariscal, W.C. Fielding, R.T. Barber, V.B. Pearse, S.J. Proctor, J.C. Ogden, J.P. Wourms, L.R. Taylor, Jr., J.G. Christofferson, J.P. Christofferson, R.M. McPhearson, M.J. Wynne, and P.M. Stromberg, Jr. 1971. [Studies on the fauna associated with the deep scattering layers in the equatorial Indian Ocean, conducted on R/V Te Vega during October and November 1964](#). G.B. Farquar (ed.), Proceedings of an International Symposium on Biological Sound Scattering in the Ocean. Maury Center for Ocean Science Report 005.
- Costello, M.J., P. Tsai, P.S. Wong, A.K.L. Cheung, Z. Basher, and C. Chaudhary. 2017. Marine biogeographic realms and species endemism. *Nature Communications* 8:1057, DOI: 10.1038/s41467-017-01121-2
- Currie, R.I. 1963. The Indian Ocean Standard Net. *Deep-Sea Research* 10:27-32.
- Kohn, A.J., and J.W. Nybakken. 1975. Ecology of *Conus* on eastern Indian Ocean fringing reefs: Diversity of species and resource utilization. *Marine Biology* 29:211-234.
- Menzel, D.W. 1962. [Instruction manual for routine measurements for the US program in biology - Woods Hole, MA, USA WHOI 1962 – 39pp.](#)
- Pearse, V.B., J.C. Ogden, and S.J. Proctor. 2016. An experiment in graduate education: A marine science adventure across the Indian Ocean. *Oceanography* 29(1):90–97, https://tos.org/oceanography/assets/docs/29-1_pearse.pdf.

[U.S. Program in Biology International Indian Ocean Expedition News Bulletin for Participants
No. 1. January 1963, Woods Hole Oceanographic Institution](#)

[U.S. Program in Biology International Indian Ocean Expedition News Bulletin for Participants
No. 2. July, Woods Hole Oceanographic Institution](#)

Watson, G.E., R.L. Zusi, and R.E. Storer. 1963. Preliminary Field Guide to the Birds of the Indian Ocean, for Use during the International Indian Ocean Expedition. Smithsonian Institution, Washington, D.C.

Appendix 1

Stations Occupied by the R/V *Te Vega* as part of the IIOE

The cruise reports from the R/V *Te Vega* are found in the references below. The cruise reports provide the basic data from the four cruises of the *Te Vega* that were part of the U.S. Program in Biology that contributed to the International Indian Ocean Expedition. The cruise reports provide a summary text report about the cruise, a list of participants, a map of the cruise track (see figures below), some description of sampling equipment, and a list of stations. At these links are also narratives from various cruise participants.

Cruise Reports

Cruise 2: https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_2_binder.pdf

Cruise 3: https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_3_binder.pdf

Cruise 4: https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_4_binder.pdf

Cruise 5: https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_5_binder.pdf

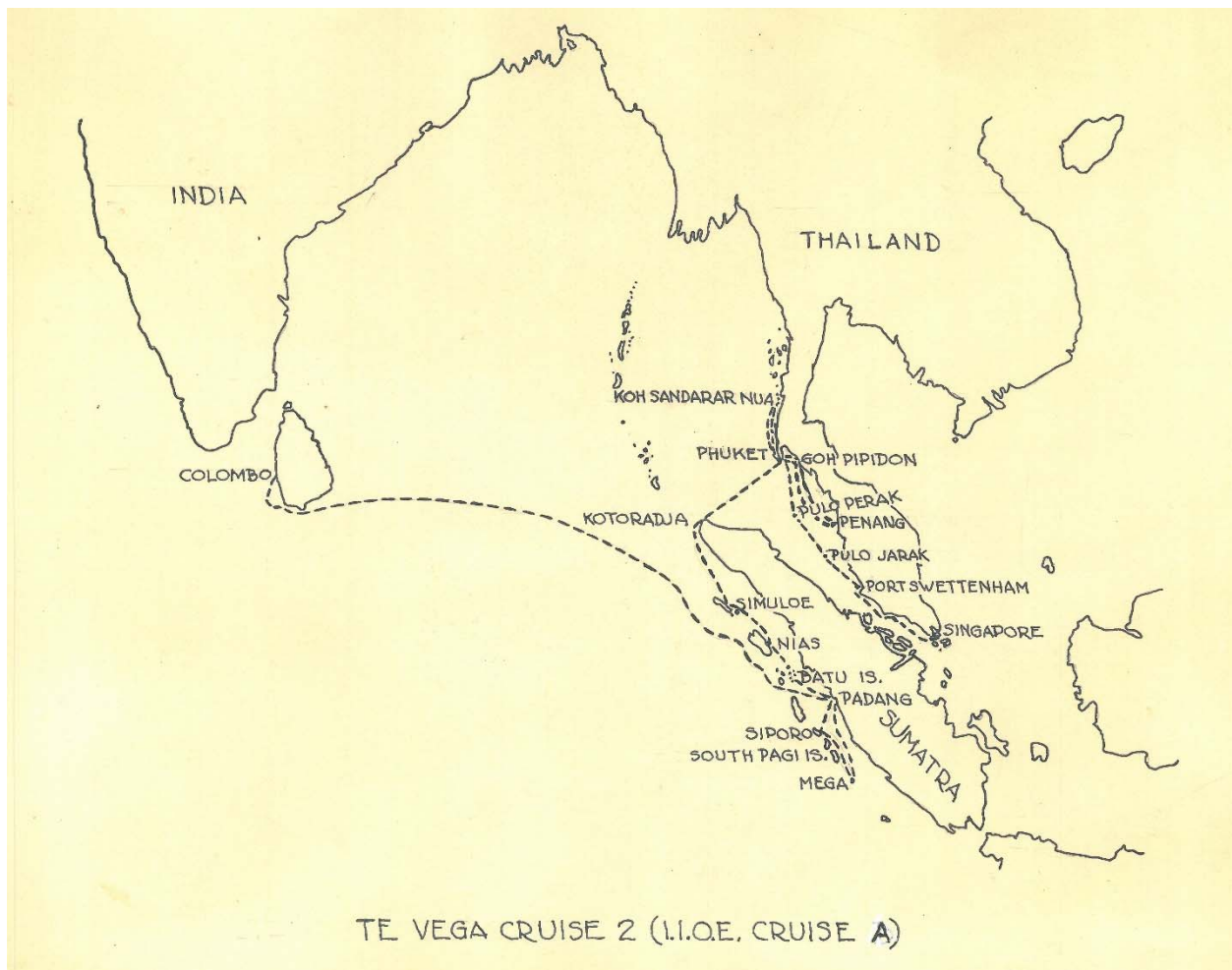


Figure 2—Cruise track for Cruise 2 of the R/V *Te Vega* for the IIOE (see https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_2_binder.pdf)

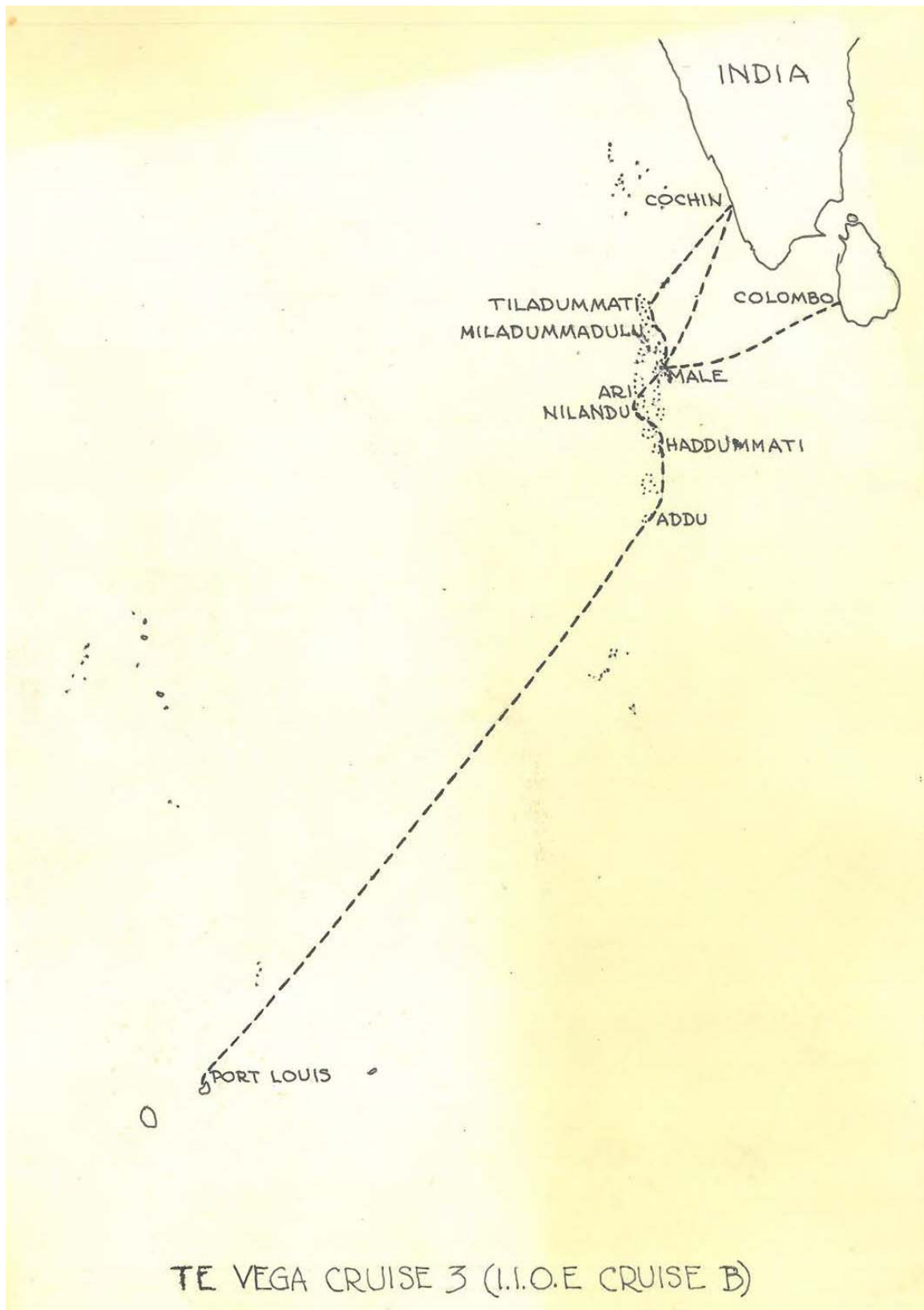


Figure 3—Cruise track for Cruise 3 of the R/V *Te Vega* for the IIOE (see https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_3_binder.pdf)

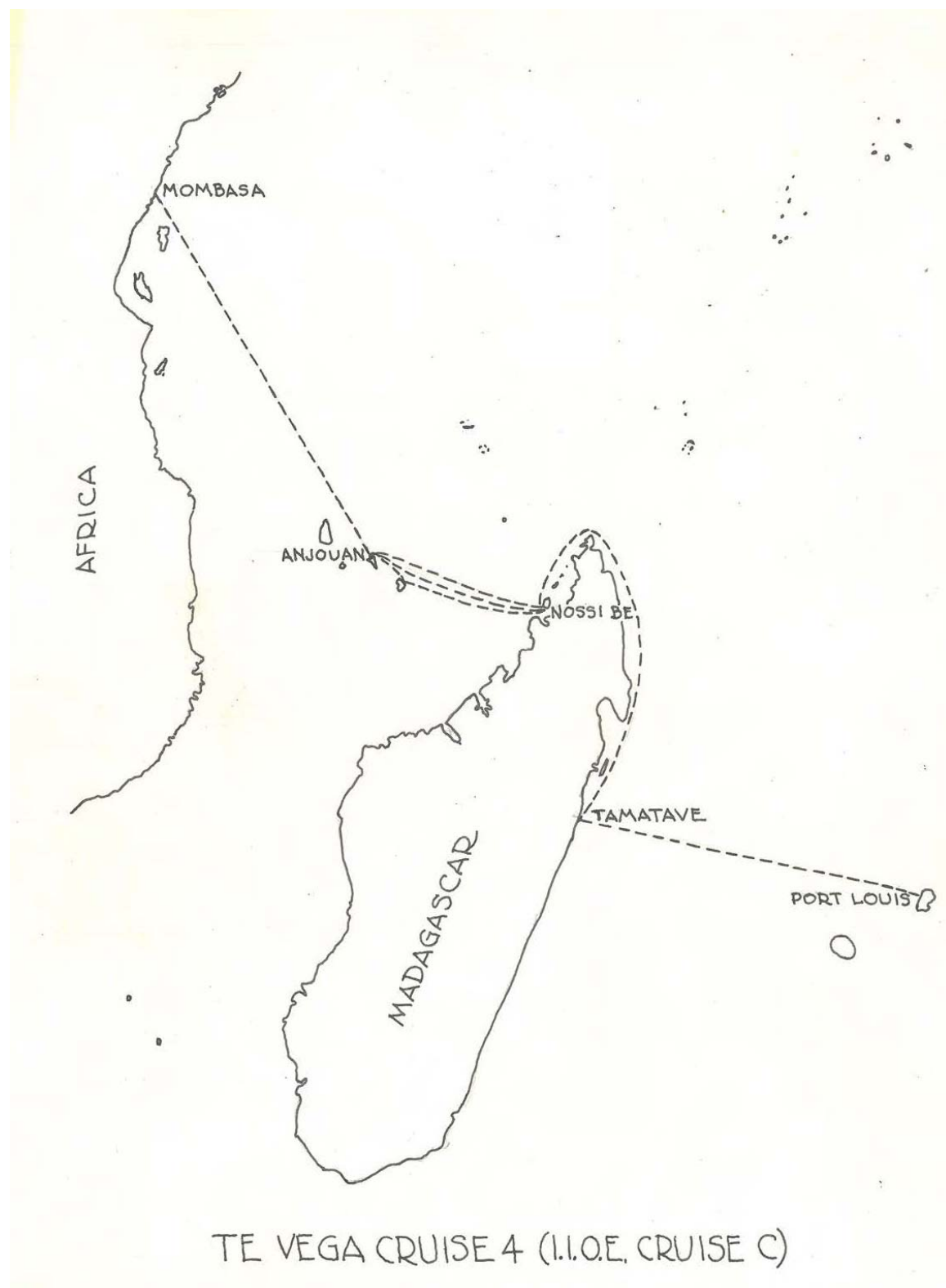


Figure 4—Cruise track for Cruise 4 of the R/V *Te Vega* for the IIOE (see https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_4_binder.pdf)

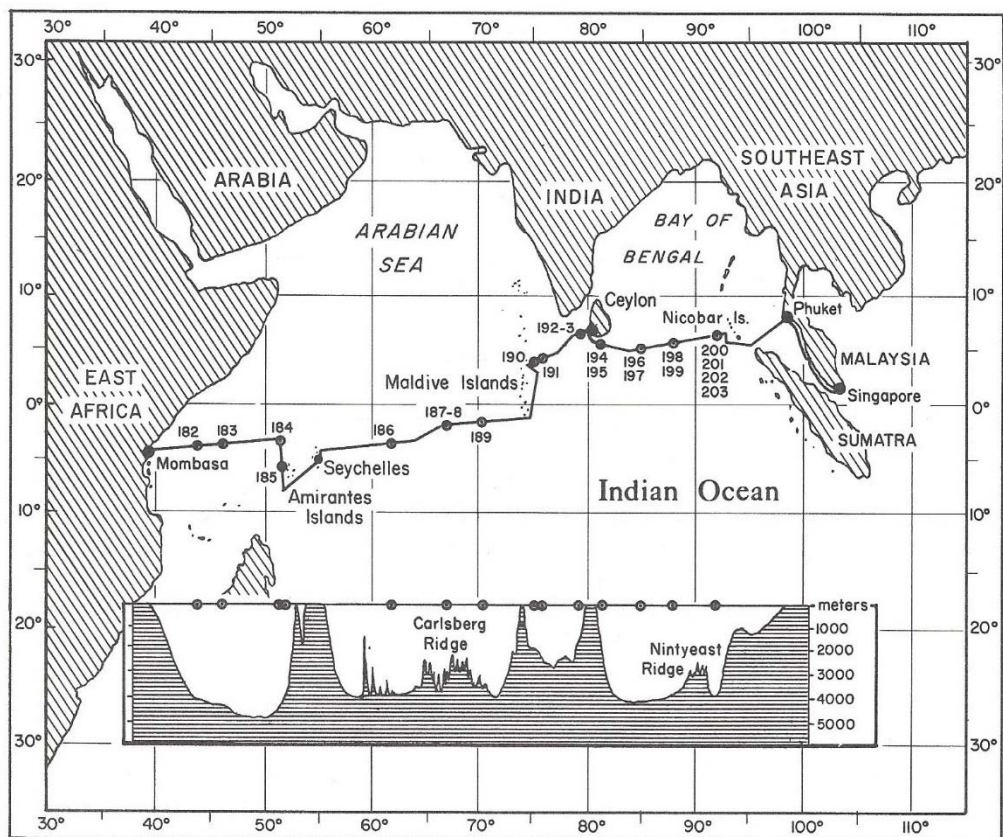


Figure 5— Cruise track for Cruise 5 of the R/V *Te Vega* for the IIOE (see https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_5_binder.pdf). Figure from Pearse et al. (2016). Permission for re-use granted by the Oceanography Society.

Appendix 2

Data from Smithsonian Institution's National Museum of Natural History

Data on specimens available at the Smithsonian Institution's National Museum of Natural History were downloaded on 10 February 2019 from <https://naturalhistory.si.edu/rc/>. Searches were done using the keyword "Te Vega" for invertebrates and fish at the following site: <https://naturalhistory.si.edu/rc/>. The botany, mammals, amphibians and reptiles, and birds databases were also searched, but no records were found.

After downloading the data, the file was sorted and the only records kept were

- records with an "Expedition Name" of "IIOE - International Indian Ocean Expedition", "IIOE", or "Deep Scattering Layer Study".
- records that did not list an expedition but listed the vessel as the "Te Vega" and were taken from the Indian Ocean in the proper time period

Records with no coordinates or dates were eliminated.

The table below shows the data from the Smithsonian archives and how they relate to the data provided in the cruise reports. Some of the Smithsonian data vary from the data in the cruise reports. The data given in the cruise reports are considered to be the authoritative data because they were recorded during the cruises. If a date range given in the cruise report coincides with a single date in the Smithsonian record or vice versa, the dates are considered equivalent.

The data in the table below fall into several categories:

- Data from the Smithsonian exactly match the data from the cruise reports. For these records, "✓" is listed in the table below.
- The cruise number, date, latitude (lat.) and/or longitude (long.) in the Smithsonian data do not match the data from the cruise report. In this case, the discrepancy is noted in the right-most column below and the alternate data are noted in the master spreadsheet.

The station numbers start with 62, since the Indian Ocean portion of the *Te Vega* Cruise 2, was actually the second leg of the cruise; the first leg was a crossing of the Pacific Ocean. Some stations only have a station number, whereas others have a letter/number combination, or several different designations. The letters most likely are special notations of specific individuals' collections: "FZ" = Fred Ziesenhenné, "GA" = J.S. Garth, "LH" = L.H. Di Salvo, "M" = E. Maujean, "MO" = Joseph Rosewater, and "RO" = R. Robertson.

Cruise	Station Number	Date Collected	Centroid Latitude	Centroid Longitude	Smithsonian Database	Discrepancies from cruise reports
	62	16-Oct-63	1.22	103.95	Invertebrates	Lat, long, date
2	64(MO-3)	16-Oct-63	1.22	103.85	Fish	✓
2		26-Oct-63	2.12	102.32	Fish	✓
2	71	30-Oct-63	3.98	100.10	Fish	✓
2	74 (MO-12; LH-8)	31-Oct-63	5.68	98.93	Fish	✓
2	75 (MO-13)	31-Oct-63	5.80	99.83	Fish, Invertebrates	✓
2	76	2-Nov-63	7.87	98.43	Invertebrates	✓
2	78	3-Nov-63	8.48	97.65	Fish, Invertebrates	✓
2	79	3-Nov-63	8.48	97.66	Fish	✓
2	80	4-Nov-63	8.77	97.77	Fish, Invertebrates	✓
2	81	5-Nov-63	9.44	97.84	Fish, Invertebrates	✓
2	84 (82F)	6-Nov-63	9.42	97.88	Fish	✓
2	87	15-Nov-63	7.67	98.80	Invertebrates	Date
2	88 (MO-20)	10-Nov-63	6.57	99.46	Fish, Invertebrates	Long
2	89	14-Nov-63	6.25	99.73	Invertebrates	✓
2	90	17-Nov-63	8.10	98.30	Invertebrates	Lat
2	91	17-Nov-63	7.88	98.28	Invertebrates	Lat
2	92	18-Nov-63	7.77	98.33	Invertebrates	Lat, long
2	93	20-Nov-63	5.55	95.16	Fish	Lat, long
A	95	21-Nov-63	3.62	95.55	Fish	Long
2	96	21-Nov-63	3.42	95.67	Fish	✓
2	97 (MO-28; LH-22; LH-22a)	22-Nov-63	2.85	95.94	Fish	Long
2	98	23-Nov-63	2.25	97.42	Fish	✓
2	99 (MO-30; LH-24)	24-Nov-63	0.68	97.89	Fish	Lat, long
2	100 (M)-31)	24-Nov-63	0.55	98.08	Fish	✓
2	101 (M)-32)	25-Nov-63	-0.03	98.52	Fish	✓
9	KA-20	27-Nov-63	-11.67	43.23	Invertebrates	Not in CRs
2	104	30-Nov-63	-2.00	99.59	Fish	✓
2	103 (MO-33)	30 Nov-1 Dec 1963	-1.98	99.58	Fish	Date
2	105 (MO-34)	2-Dec-63	-3.24	100.43	Fish	Long
2	106	3-Dec-63	-4.02	101.02	Fish	Long
2	112	6-Dec-63	-3.45	100.68	Fish	✓
3	FZ-64-5	Feb-64	6.03	80.21	Invertebrates	

3	FZ 64-1	10-Feb-64	9.75	79.17	Invertebrates	Not in CRs
3	FZ-64-2	10-Feb-64	9.25	79.17	Invertebrates	Not in CRs
3	GA-64-3	11-Feb-64	5.95	73.40	Invertebrates	Not in CRs
3	FZ 64-4	12-Feb-64	9.27	79.21	Invertebrates	Not in CRs
3	FZ 64-6	22-Feb-64	9.33	79.13	Invertebrates	Not in CRs
3	FZ-64-7	28-Feb-64	6.45	79.96	Invertebrates	Not in CRs
3	GA64-15	4-Mar-64	6.00	80.24	Invertebrates	Not in CR
3	115	5-Mar-64	6.03	80.20	Invertebrates	Date, long
3	FZ-64-8	5-Mar-64	6.03	80.18	Invertebrates	Not in CRs
3	117	18-Mar-64	4.19	73.51	Invertebrates	Long
3	FZ-64-9	18-Mar-64	7.19	73.51	Invertebrates	Not in CRs
3	FZ-64-19	19-Mar-64	5.97	73.32	Invertebrates	Not in CRs
3	118	20-Mar-64	4.31	73.57	Invertebrates	Long
3	FZ-64-11	21-Mar-64	4.30	73.56	Invertebrates	Not in CRs
3	120	22-Mar-64	4.55	73.57	Invertebrates	Lat
	GA-64-25	23-Mar-64	5.36	73.42	Invertebrates	Not in CRs
	GA-64-23	24-Mar-64	10.65	96.58	Invertebrates	Not in CRs
	GA 64-26A	25-Mar-64	5.33	73.48	Invertebrates	Not in CRs
3	123	27-Mar-64	5.94	73.40	Invertebrates	✓
3	FZ 64-20	30-Mar-64	6.92	73.20	Invertebrates	✓
125	GA 64-29A	31-Mar-64	6.90	73.22	Invertebrates	Not in CRs
	GA-64-31B	11-Apr-64	10.00	76.24	Invertebrates, Fish	Not in CRs
3	FZ-64-21	17-Apr-64	9.83	76.03	Invertebrates	Not in CRs
3	129	21-Apr-64	5.68	73.00	Fish	✓
3	130	22-Apr-64	4.10	72.75	Invertebrates	✓
3	132	24-Apr-64	2.70	72.88	Fish	✓
3	R029	29-Apr-64	-0.68	73.15	Invertebrates	Not in CRs
3	133	30-Apr-64	-0.68	73.19	Invertebrates	Long
between 3 & 4		8-May-64	-0.68	73.14	Invertebrates	Not in CRs
4	134	5-Jun-64	-20.58	57.92	Fish	Long
4	138	12-Jul-64	-12.17	44.39	Fish	✓
4	139	13-Jul-64	-12.12	44.33	Invertebrates	✓
4	141	15-Jul-64	-12.12	44.33	Fish	✓
4	142	16-Jul-64	-12.12	44.25	Fish, Invertebrates	✓
4	143	16-Jul-64	-12.13	44.37	Fish	✓
4	145	16-Jul-64	-12.13	44.37	Invertebrates	Date
4	146	18-Jul-64	-12.15	44.38	Fish	✓
4	147	18-Jul-64	-12.13	44.35	Fish, Invertebrates	✓
4	148	18-Jul-64	-12.12	44.33	Fish	✓
4	150	17-18 Jul 1964	-12.13	44.37	Fish	Date
4	151	19-Jul-64	-12.18	44.35	Fish	✓

4	154	20-Jul-64	-12.13	44.33	Fish, Invertebrates	✓
4	157	21-Jul-64	-12.13	44.33	Fish	✓
4	161	31-Jul-64	-13.41	48.31	Fish	✓
4	163	5-Aug-64	-13.69	48.17	Fish	✓
4	164	6-Aug-64	-13.35	48.33	Fish	✓
4	165	7-Aug-64	-13.48	48.25	Fish	✓
4	167	16-Aug-64	-12.05	44.42	Fish	✓
4	168	16-Aug-64	-12.07	44.38	Fish, Invertebrates	✓
4	170	16-Aug-64	-12.14	44.38	Invertebrates	Lat
4	171	17-Aug-64	-12.12	44.37	Fish	✓
4	172	17-Aug-64	-12.12	44.38	Fish, Invertebrates	✓
4	174	18-Aug-64	-12.12	44.37	Fish	✓
4	175	19-Aug-64	-12.10	44.35	Fish, Invertebrates	✓
4	177	20-Aug-64	-12.10	44.37	Fish	✓
4	179	21-Aug-64	-12.17	44.38	Fish	✓
5	182	7-Oct-64	-3.38	43.73	Fish, Invertebrates	✓
5	184	10-Oct-64	-3.37	51.25	Fish, Invertebrates	✓
5	185	11-Oct-64	-5.25	51.45	Invertebrates	✓
5	186	29-Oct-64	-3.25	61.47	Fish, Invertebrates	✓
5	188	31-Oct-64	-1.63	66.47	Fish, Invertebrates	✓
5	189	1-Nov-64	-1.12	69.62	Fish, Invertebrates	✓
5	190	9-Nov-64	4.45	74.25	Invertebrates	Lat
5	191	10-Nov-64	4.42	74.95	Fish, Invertebrates	✓
5	192	11-Nov-64	6.72	78.78	Fish, Invertebrates	✓
5	193	11-Nov-64	6.72	78.78	Fish	✓
5	194	20-Nov-64	5.77	81.22	Fish, Invertebrates	✓
5	195	20-Nov-64	5.77	81.22	Fish	✓
5	196	21-Nov-64	5.10	84.85	Fish, Invertebrates	✓
5	197	21-Nov-64	5.10	84.85	Fish	✓
5	198	23-Nov-64	5.73	88.40	Fish	✓
5	199	23-Nov-64	5.73	88.40	Fish	✓
5	200	24-Nov-64	6.00	92.02	Invertebrates	✓
5	202	24-Nov-64	6.08	92.10	Invertebrates	✓
5	203	24-Nov-64	6.08	92.10	Fish	✓
5	RV-286	24-Nov-64	-11.83	45.30	Invertebrates	Not in CRs

Appendix 3

Notes on Equipment Used as Part of R/V *Te Vega* Cruises

Sampling details are described in each cruise report. Additional information about the sampling equipment is provided below and is available from (U.S. Program in Biology, 1963). All sampling equipment and methods are included for completeness of the record, even though descriptions of some methods were not found.

- **½ meter net**
- **Bird shooting:** a “16 gauge polychoke shotgun using No. 6 7 half shot” was used on at least Cruise 3. The polychoke is an attachment for a shotgun mussel that controls the spread of the pellets leaving the gun
(https://seaside.stanford.edu/sites/g/files/sbiybj8686/f/soe_cruise_3_binder.pdf)
- **Dip net:** a net attached to a pole and deployed from shore or from the decks of ships.
- **Dredging:** dredges are metal devices designed to be dragged across the seafloor to collect rocks and organisms on the seafloor or slightly below the seafloor. Samples are collected in bags connected to the dredges. A 2-ft dredge is mentioned in the cruise reports.
- **Fish trap:** a sampling device in which bait is put into an inside compartment to attract fish. Fish enter the trap through a hole or conical entrance from which they cannot exit.
- **Hand sampling:** typically involves walking on exposed seafloor at low tide or in shallow water, or using skin or scuba diving, and collecting specimens observed.
- **Hook and line:** Fishing line to which a fish hook is attached. The line may be wound around a reel, which allows the line to be let out and pulled in by an individual fisherman, and active hooking of individual fish. Includes fishing from stationary and moving (i.e., trolling) boats. The line may also be let out by hand (hand line).
- **Hydrographic station:** often involved measuring temperature, salinity, and sometimes oxygen and nutrients.
- **Long line:** a horizontal fishing apparatus with hooks deployed at regular intervals from separate lines.
- **Minnow seine:** a net with small mesh used to catch small fish from shore or a boat.
- **Nansen bottle:** a hollow cylinder used to collect water samples at depth. One or more Nansen bottles were attached to a vertical line. The bottles are open until a “messenger” is sent down the line to trip a release mechanism at the top of the bottle, flipping it over and triggering the ends of the bottle to close, causing a sample to be trapped within the bottle, to be hauled back up to the sampling vessel.
- **Night lighting:** lights are deployed on the research vessel at night, attracting organisms to the surface, where they can be netted with a dip net.
- **Plankton haul using 1-meter net:** This may be the Indian Ocean Standard net (Currie, 1963), but it is not indicated. Tows were made from 200-meter depth vertically to the surface. This net was used on all the large ships to make standard plankton hauls.

- **Poison Station:** sampling station in which poison (e.g., often rotenone) was applied in an enclosed basin, such as a tide pool or small pond in a coral reef at low tide to cause all fish to leave their hiding places and come to the surface, where they can be collected.
- **Self-Contained Underwater Breathing Apparatus (SCUBA):** used by individuals for hand collecting of specimens below the sea surface
- **Skin diving:** swimming with mask, snorkel, and/or fins and hand collecting specimens
- **Spearfishing:** collecting specimens, usually fish, using a speargun
- **Transects:** collections at regular intervals along a straight line or in a grid pattern, usually to describe densities and/or distributions of different species.
- **Trawls:** fishing nets towed behind a vessel along the bottom or in the mid-water. Trawls typically have rectangular iron frames with netting attached to the mouth of the frame to catch organisms. Two types of trawls are listed among the sampling equipment on the *Te Vega*:
 - **6-ft beam trawl:** beam trawls have horizontal beams made of wood or metal to support the opening of the trawl net, which has a conical shape with a bag (or cod-end) at the end to retain the catch.
 - **10-ft Tucker trawl:** a mid-water trawl used to collect zooplankton, which can be opened and closed at depth.