



Activity #1

Navigating the Currents

● ● ● In Advance *Student Reading*

Assign the Student Page “Navigating the Currents” (pp. 15-19) as homework. (Students should bring this reading to class with them.)

● ● ● Class Period One *Charting a Course*

Materials & Setup

- “Map of Pacific Ocean Currents” acetate (master, p. 12)
- “Reference Course and Course Heading Map” acetate (master, p. 13)
- “Map of Currents Between Hawai‘i and Nuku Hiva” acetate (master, p. 14)
- Overhead projector and screen

For each group of three to six students

- Student Page “From Nuku Hiva to Hawai‘i: Charting a Course” (pp. 20-27)

For each student

- Student Page “Navigating the Currents” (pp. 15-19)

Instructions

- 1) Show the “Map of Pacific Ocean Currents” acetate to put Hawai‘i and Nuku Hiva (in the Marquesas Islands) in context. Ask students if they know which main South Pacific island group the islands of Hiva belong to. (They are in the Marquesas, a part of the “French Polynesia” group of islands.)
- 2) Divide the class into groups of three to six students. Explain that each group is a team in a voyaging canoe race from Nuku Hiva to Hawai‘i. There are just a few more details to complete in planning their journey before they can set sail.
- 3) Give each group a copy of the Student Page “From Nuku Hiva to Hawai‘i: Charting a Course.” Groups should work cooperatively to complete the assignment quickly and accurately. The rest of the crew of *Hōkūle‘a* is waiting for them—the wayfinders—to complete their work.
- 4) Allow groups about 20 minutes to complete the student page. If no groups are finished at the end of 20 minutes, you may allow more time. If a few groups finish before 20 minutes are up, quickly check their work to see if there are any obvious flaws they need to correct.
- 5) When all groups have finished, review the assignment asking groups for their responses to each of the tasks on the student page. Use the teacher version of the Student Page “From Nuku Hiva to Hawai‘i: Charting a Course” (pp. 9-11) and the “Reference Course and Course Heading Map”



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acetate (which charts the correct course headings). As additional background, you may use the “Map of Currents Between Hawai‘i and Nuku Hiva” and the notes in the Teacher Background “Wind and Current Zones in the Pacific” (pp. 7-8).

Journal Ideas

- If you were an ancient Polynesian setting off to settle a distant island, what would you take with you for the trip? What would you take with you to survive in your new home?
- After a month or more at sea, what do you think it feels like for voyagers to sight land?
- What do you think you would feel if you were a voyager stepping ashore? Write a chant or poem that reflects those feelings.
- How do you think Polynesian navigation compares to the way in which fish, corals, and other marine animals originally reached the Hawaiian Islands? Explain your reasoning.

Assessment Tools

- Student Page “From Nuku Hiva to Hawai‘i: Charting a Course” (teacher version, pp. 9-11; correct course headings charted on “Reference Course and Course Heading Map” acetate, master, p. 14)
- Participation in group work and class discussions
- Journal entries



Teacher Background

Wind and Current Zones in the Pacific

Based on “Winds, Weather, and Currents of the Pacific” from the Polynesian Voyaging Society website at <leahi.kcc.hawaii.edu/org/pvs>, June 2000. Quotations are from William G. Van Dorn, *Oceanography and Seamanship, 2nd ed.*, Cornell Maritime Press, Centerville, Maryland, 1993.

Voyagers among the islands of Polynesia travel through several different zones marked by distinct wind and current patterns. This summary will help you understand these zones and explain them to students.

Northeast Trade Wind Belt (25° N to 9° N)

Winds

- Northeast trade winds, generally from the east, north east (ENE or ‘Aina Ko‘olau)
- Ten to twenty knots
- Produced by air circulating clockwise around an area of high pressure centered northeast of Hawai‘i
- Summer: trade winds prevail about 90 percent of the time
- Winter: trade winds blow 40-60 percent of the time and are more easterly and generally lighter. Episodes of strong, gusty trade winds are a bit more frequent than during the summer months. Occasional Kona storms bring southerly winds and rain. Winter and spring cold fronts from storms in the North Pacific bring southwesterly winds and rain, followed by cool, dry northerly winds.
- Squalls in the trade wind flow may carry brief bursts of wind up to 40 knots.

Currents

- North equatorial current driven by northeast trade winds
- West-flowing at about .5 knots (12 nautical miles per day)

Intertropical Convergence Zone—ITCZ (varies between 10° N to 0°)

The ITCZ shifts around but, on average lies between 9° N and 3° N between Hawai‘i and South Pacific island groups such as the Marquesas and Tahiti Nui.

Winds

- Variable, generally out of the east (*Hikina*)
- Zero to ten knots
- Conditions caused by converging winds from the northeast and southeast trade wind belts and warm air rising from equatorial waters
- Doldrum conditions: variable winds, calms, thunderstorm activity, and dense cloud cover
- The zone is characterized by an “impressive wall of clouds,” and a “confused state of the swell, flukey winds that blow intensely and then subside, and intermittent showers of rain that come from nowhere in a solid, opaque overcast” (Van Dorn).



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- The light, shifting winds and the confused swells and cloud cover make sailing slow and navigation difficult.
- Sometimes, however, cloudless skies and easterly winds prevail across the zone.

Currents

- Equatorial countercurrent
- East-flowing, but unpredictable
- Sporadic and shifting
- Generally weakest in May/June and strongest in September through November, when its speed can reach about one knot
- Occasionally becomes stronger (This happened in 1992, for example, when the El Niño weather condition brought westerly winds and dangerous winds to the southern Pacific.)

Southeast Trade Wind Belt (0° to 25° S)

Winds

- Southeast trade winds, generally from the east (*Hikina*), east by south (E by S or *La Malanai*), or east by south east (ESE or *'Aina Malanai*)
- Ten to twenty knots
- “Generally stronger, steadier, and cover a much wider zone of latitudes” (Van Dorn) than the northeast trade winds
- Produced by air circulating counterclockwise around an area of high pressure centered around 30° S and stretching westward off the coast of South America
- During the southern hemisphere summer and fall (December-April), infrequent hurricanes form around Tahiti.

Currents

- South equatorial current, driven by southeast trade winds
- West-flowing at .5 knots

For More Information

- On the global air circulation patterns that cause the trade winds and westerlies, see Alpine/Aeolian Unit 2 “Summer Every Day and Winter Every Night,” for background.
- On ocean currents and what causes them see Pierre Flament, et al., “The Ocean,” *Atlas of Hawai‘i*, 3rd ed., University of Hawai‘i Press, 1998, pp. 82-86.



Teacher Version

From Nuku Hiva to Hawai'i: Charting a Course

Task #1: Check the Weather

Safest month or months for *Hōkūle'a* to sail:
April or May (or both)

Rationale:

To avoid the likelihood of either winter storms or hurricanes in either hemisphere

Task #2: Confirm Your Target Screen

Sighting distances and calculations:

Mauna Kea Square root 9 + square root 13,796 = Distance
 3 + 117.5 = Distance
 120.5 nautical miles

Haleakalā Square root 9 + square root 10,023 = Distance
 3 + 100.1 = Distance
 103.1 nautical miles

Kawaikini Square root 9 + square root 5,243 = Distance
 3 + 72.4 = Distance
 75.4 nautical miles

[Using the formula: Square root of h + square root of H = distance in nautical miles from which an object can be seen (h = height of the observer above sea level in feet, H = height of the object in feet)]

Given the average range of seabirds such as the *noio* and *manu o Kū*, would you be likely to see these landmarks first, or would seabirds likely give away the presence of islands nearby first?

You'd probably see the islands first, since the average range of these seabirds is 60 miles from the island. (Information provided in the Student Page "Navigating the Currents.")



Task #3: Finalize Your Sailing Plan

Segment 1: In the Southeast Tradewinds

Latitudes: 9°S to 3° N

Average canoe speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Average distance traveled per day: 5 knots x 24 hours = 120 miles/day

Total distance to be traveled: 710.6 miles

Total number of days for this segment: 5.9 days

Expected total distance and direction of drift due to the current: .5 knots W x 24 hours = 12 miles west per day x 5.9 days = 70.8 miles west

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map. See “Reference Course and Course Heading Map” (p. 13) acetate for answer.

Segment 2: In the Intertropical Convergence Zone

Latitudes: 3°N to 9°N

Average canoe speed: 7.5 knots average wind speed x 1/3 wind speed = 2.5 knots

Average distance traveled per day: 2.5 knots x 24 hours = 60 miles/day

Total distance to be traveled: 368.1 miles

Total number of days for this segment: 6.1 days

Expected total distance and direction of drift due to the current: Not factored in because it's so variable

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map. See “Reference Course and Course Heading Map” (p. 13) acetate for answer.



Segment 3: In the Northeast Tradewinds

Latitudes: 9°N to 20° 30' N

Average canoe speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Average distance traveled per day: 5 knots x 24 hours = 120 miles/day

Total distance to be traveled: 785.3 miles

Total number of days for this segment: 6.5 days

Expected total distance and direction of drift due to the current: .5 knots W x 24 hours = 12 miles west per day x 6.5 days = 78 miles west

Heading: Between N by W and NNW

Determine the actual heading with current factored in and draw it on the reference course map. See “Reference Course and Course Heading Map” (p. 13) acetate for answer.

Segment 4: Westward to Hāna

Latitudes: 20° 30' N to 20° 45' N

Average canoe speed based on wind speed: 15 knots average wind speed x 1/3 wind speed = 5 knots

Expected HOURLY distance and direction of drift due to the current: .5 knots west

Expected actual performance of the canoe (add speed based on wind and current together): 5.5 knots

Average distance traveled per day: 5.5 knots x 24 hours = 132 miles

Total distance to be traveled: 405.3 miles

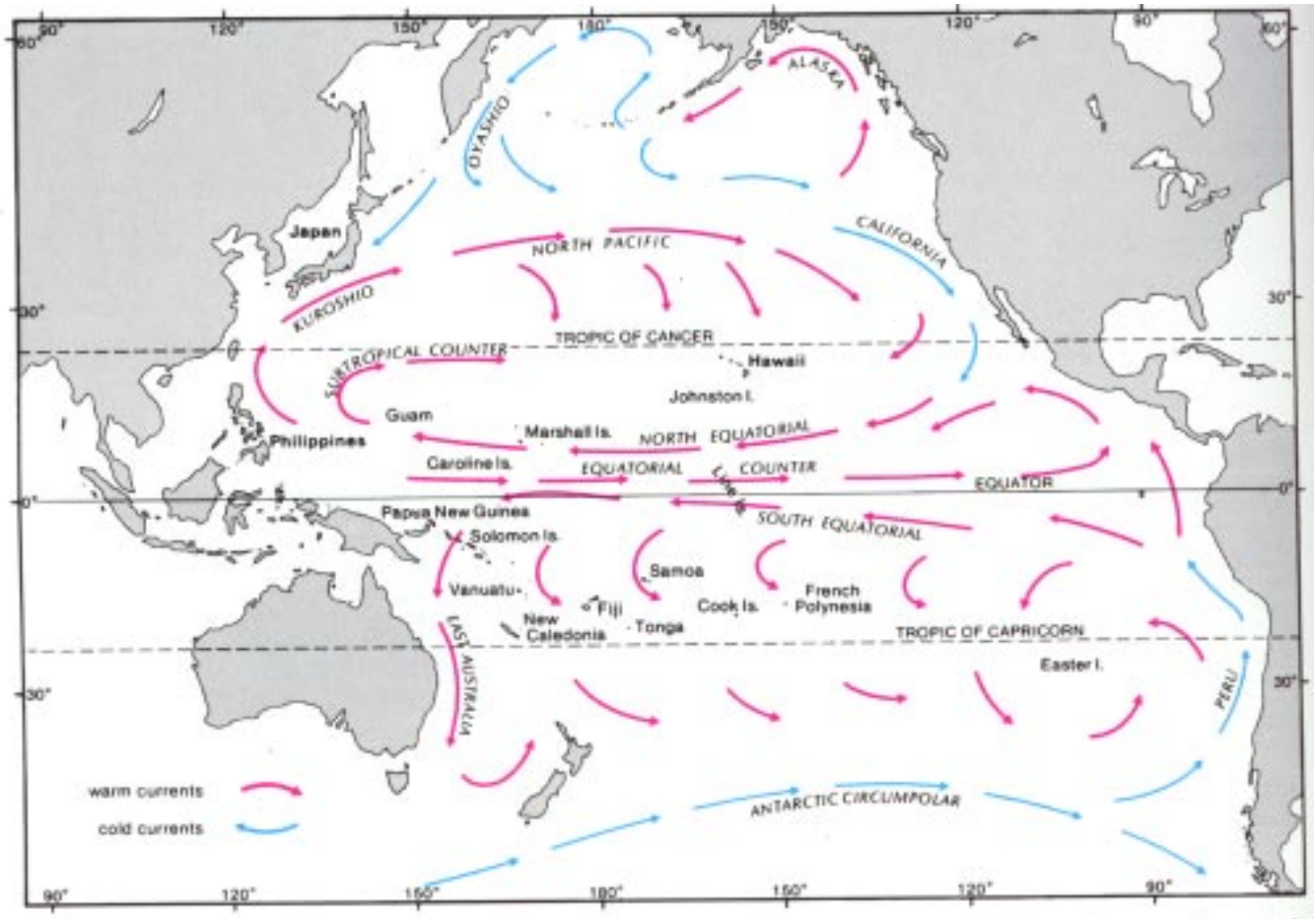
Total number of days for this segment: 3.1 days

Heading: W

Determine the actual heading with current factored in and draw it on the reference course map. See “Reference Course and Course Heading Map” (p. 13) acetate for answer.



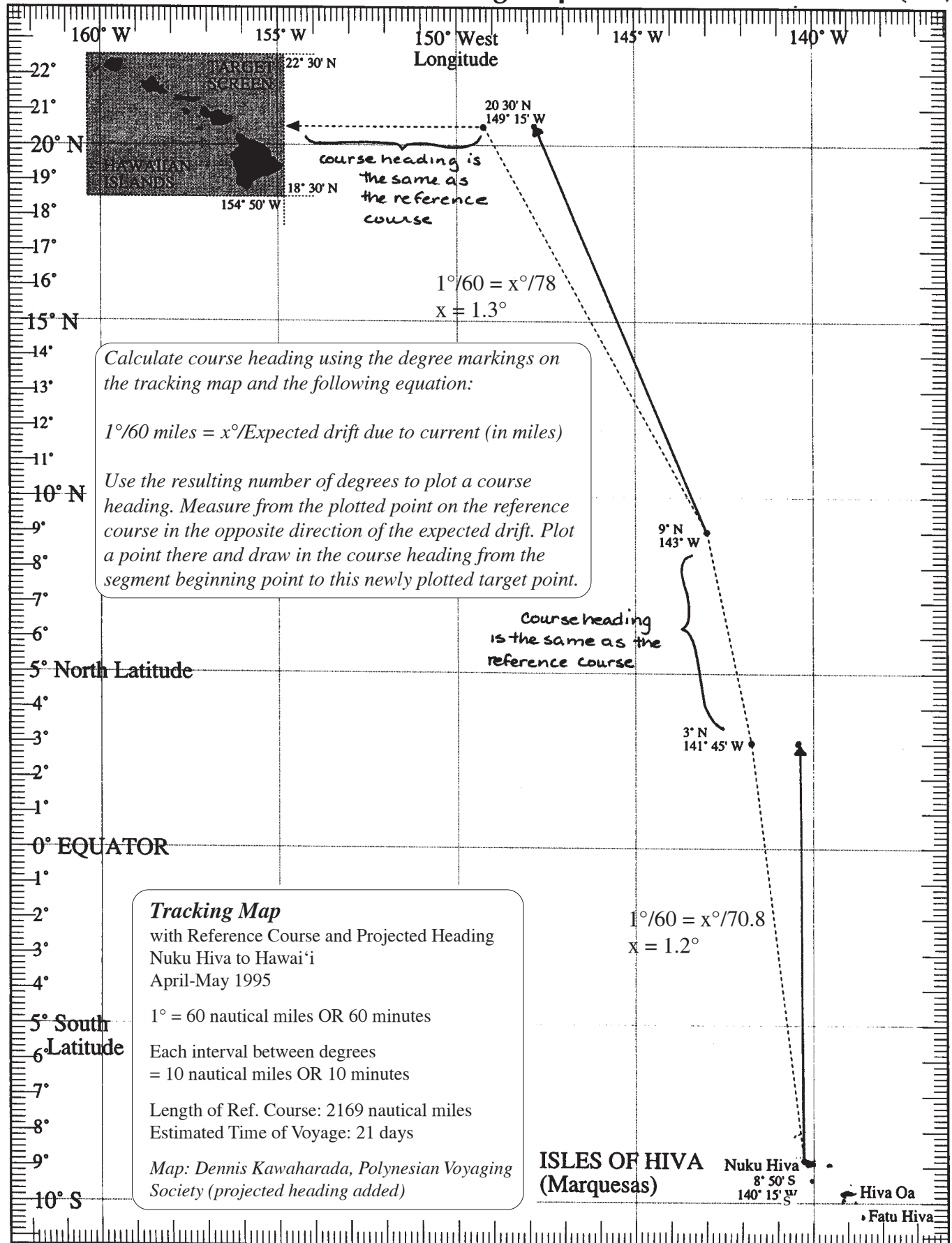
Map of Pacific Ocean Currents



Map: Ann Fielding and Ed Robinson, *An Underwater Guide to Hawai'i*, University of Hawai'i Press, Honolulu, 1987.



Reference Course and Course Heading Map



Tracking Map
with Reference Course and Projected Heading
Nuku Hiva to Hawai'i
April-May 1995

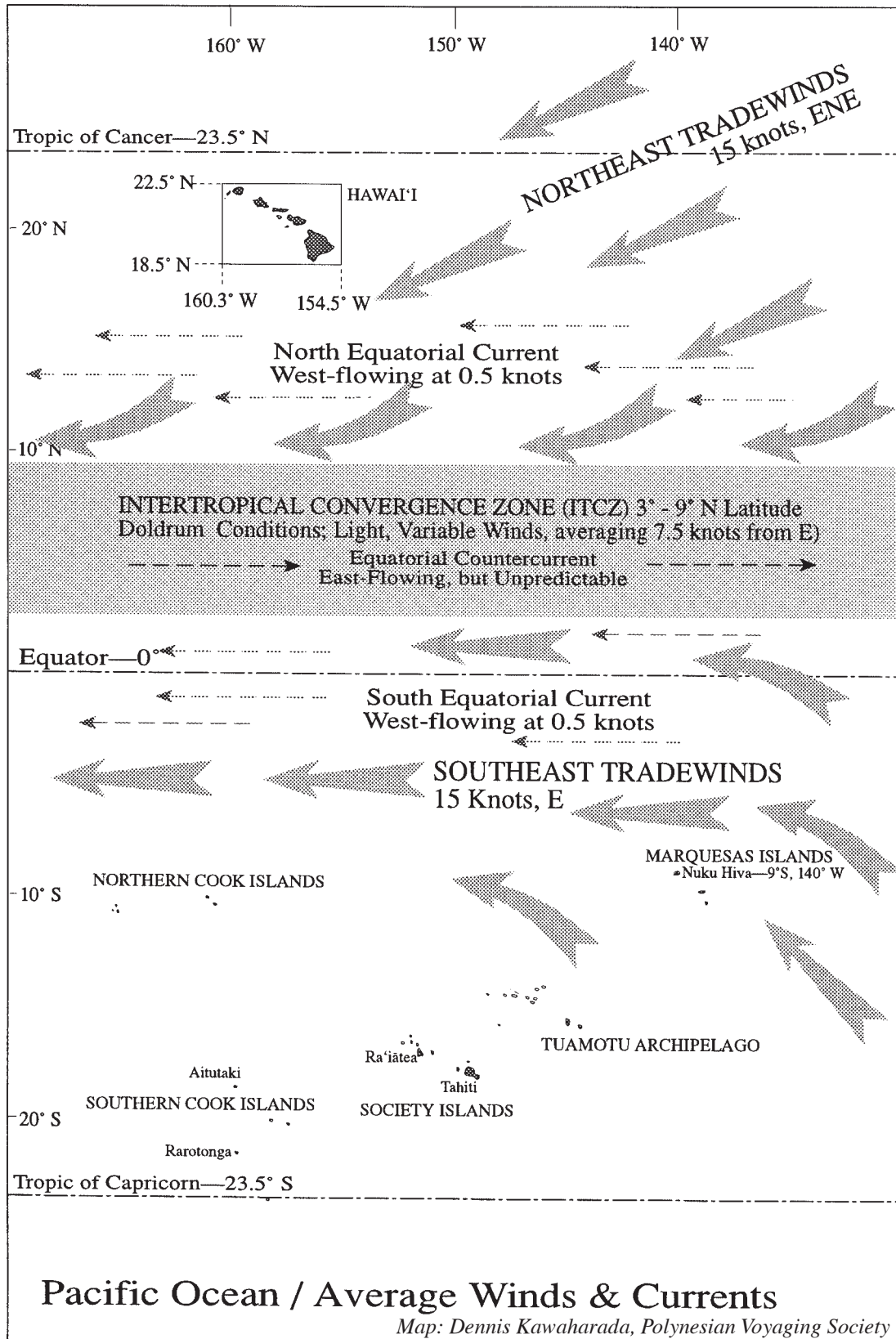
1° = 60 nautical miles OR 60 minutes
Each interval between degrees = 10 nautical miles OR 10 minutes

Length of Ref. Course: 2169 nautical miles
Estimated Time of Voyage: 21 days

Map: Dennis Kawaharada, Polynesian Voyaging Society (projected heading added)



Map of Currents Between Nuku Hiva and Hawai'i





Navigating the Currents

Adapted from “Virtual Voyage: Course Strategy and Departure Time” and other sections of the Polynesian Voyaging Society website at <leahi.kcc.hawaii.edu/org/pvs>, June 2000.

Imagine that you are a wayfinder. Through long years of study and practice, you have learned the traditional art of guiding a Hawaiian voyaging canoe to its destination without using instruments. You have learned to listen to subtle differences in the sound or thrust of the ocean swell on the wooden hulls of the canoe, use the stars and the sun to determine your position and time of day, and estimate the wind speed and direction. You know how to put all of the signs together to interpret where you are in the vast expanses of the Pacific Ocean, and whether you’re on course for your destination. While you’re underway, you do all of this on as little as two hours of sleep each night, because the success of your journey and the lives of the entire crew depend upon your constant attention to navigating.

You have guided the crew of the *Hōkūleʻa*, the first Hawaiian voyaging canoe built in modern times, from Maui to the South Pacific island of Nuku Hiva. Now, after sharing food, fellowship, and traditional dance and song with your Polynesian ‘ohana, you are ready to plan your journey home.

Charting a Course

As wayfinder, your job starts well before the canoe leaves shore. You must design an ideal course for sailing from Nuku Hiva back home to Maui. To do that, you will consider the capabilities of the canoe along with the winds, currents, and weather conditions anticipated along the way. As a modern-day wayfinder, you have a couple of advantages over your ancient counterparts: accurate ocean and current maps, and measured average current and wind conditions for different parts of the ocean and different seasons of the year.

Still the ideal course you chart is only a model of what your course will really look like once the *Hōkūleʻa* is under sail. It is called a “reference course” because you will use it as a point of reference during the voyage. This course is based on average wind and current conditions, and on the ocean these conditions are never average. The canoe deviates from its reference course, sailing in whatever direction the winds allow it to sail. During the voyage, as the wind or ocean currents push *Hōkūleʻa* off its reference course, you will eventually try to get the canoe back on it or close to it when conditions allow.

Under Sail

Once *Hōkūleʻa* leaves the shores of Nuku Hiva, your job as wayfinder is to plot the canoe’s position relative to the reference course. Charting the canoe’s position is a matter of educated estimation. You plot the position of the vessel by estimating:

- 1) The speed and direction in which the canoe is traveling,
- 2) The speed and direction of ocean currents, and



Sightings of seabirds such as this albatross tell Polynesian navigators there is land within about 60 miles. (Photo: Kim Martz and Forest Starr)



- 3) Latitude (based on measurements of the altitudes of stars crossing the meridian).

In keeping with Polynesian tradition and techniques, you make these estimates without instruments. They can be hampered by poor weather conditions that obscure the sky and make patterns in ocean “swells” (long, crestless waves or successions of waves generated by weather events such as storms) difficult to interpret. Since the speed and direction of ocean currents cannot be estimated without instruments, you, a modern-day wayfinder, use seasonal averages to calculate your position.

Finding Land

Your goal is not to stay on the reference course, but to guide *Hōkūle‘a* back home to Maui. The art of wayfinding involves adapting to variable and unexpected conditions of wind and weather while maintaining progress toward the windward side of the Hawaiian Islands.

As repeated landfalls by *Hōkūle‘a* in its many journeys since 1976 show, wayfinding does not require exact positions to be successful. The wayfinder will successfully guide the canoe to its destination by keeping track of where the canoe is in relation to the reference course and destina-

A Revival of Polynesian Voyaging

Over a period of some one thousand years, Polynesian navigators explored and settled islands in an area covering over ten million square miles. How they accomplished this has been the subject of much speculation for centuries. Since 1976, the Polynesian Voyaging Society has helped scientists, anthropologists, archaeologists, and others interested in the survival of Polynesian culture understand how that achievement happened. In traditional-style Polynesian voyaging canoes, Hawaiians have traveled throughout the Pacific, navigating using only the constellations, wind, and wave patterns to guide their voyages over thousands of miles of open ocean.

The first Hawaiian voyaging canoe built in modern times was *Hōkūle‘a*. Construction on *Hōkūle‘a* started in 1973, and the canoe finished in 1975. Since then, *Hōkūle‘a* and its crew have sailed between Hawai‘i and the

South Pacific, visiting islands including Tahiti, Rapa Nui, Raratonga, and the Marquesas. In 1995, *Hōkūle‘a* and another voyaging canoe, *Hawai‘iloa*, were shipped to Seattle where they traveled up and down North America’s Pacific coast from Juneau, Alaska, to San Diego, California.



Hōkūle‘a (Photo: Steve Anderson)



tion, guiding the canoe to the general vicinity of the destination, locating land in that vicinity, and using known landmarks to find the destination.

In class, you will work with a team to create a sailing plan based on the reference course for a voyage of *Hōkūleʻa* from Nuku Hiva in the Marquesas Islands to Hāna on the eastern coast of Maui. In the process, you will learn more about the ocean currents and winds that surround the Hawaiian Islands. And you'll need to know a bit more about the capabilities of *Hōkūleʻa*. Here is some background that will help you as you learn this part of the art of wayfinding.

Sailing *Hōkūleʻa*

Hōkūleʻa has two 19-meter (62-foot) hulls, joined by eight crossbeams. No nails were used in constructing the canoe, so the decking is lashed to the crossbeams, and there are two masts. The 7.25-metric-ton (eight-ton) *Hōkūleʻa* can be loaded with about 4990 kilograms (11,000 pounds), including a crew of 12-16 people, along with their equipment and supplies.

Unlike most modern sailing vessels, Polynesian voyaging canoes like *Hōkūleʻa* have no keels or dagger boards at the bottom of their hulls to stabilize them in the water. This means that their “windward ability”—the ability to sail into the wind—is more limited than many modern craft. Still the canoes can sail in a broad range of wind conditions.

Hokuleʻa travels at an average of one-third of the wind speed. Wind speed is measured in “knots.” One knot is equal to one “nautical mile” per hour. *Hokuleʻa* can make up to 10-12 knots under the best wind conditions. (A nautical mile is based on the length of a minute of arc of a great circle of the earth. According to the international standard, this distance is 1852 meters or 6076.115 feet.)

Crossing the Currents

The Hawaiian Islands are the northernmost and most isolated island group in Polynesia. Voyaging between Nuku Hiva in the South Pacific Ocean

and the Hawaiian Islands in the North Pacific, you will pass through several zones characterized by particular current and wind conditions. There are three major current and wind zones (see the map on page 18):

South East Trade Wind Belt

Steady winds from the east/east south east (E/ESE) drive the south equatorial current, which flows westward through the trade wind belt.

Intertropical Convergence Zone

This area, where the southeast and northeast trade wind systems converge, is noted for its heavy cloud cover, squalls, light and variable winds, and dead calms—all of which make sailing and navigating less than ideal. The windless weather, known as the “doldrums,” could stall *Hōkūleʻa* for days. The heavy cloud cover hides the stars, so navigating by them is difficult. Under such conditions, you must use the ocean swells to orient the canoe. However, the seas in this area are often “confused.” Because the winds (which cause ocean swells) are so variable, there are often no clear swell patterns by which to navigate.

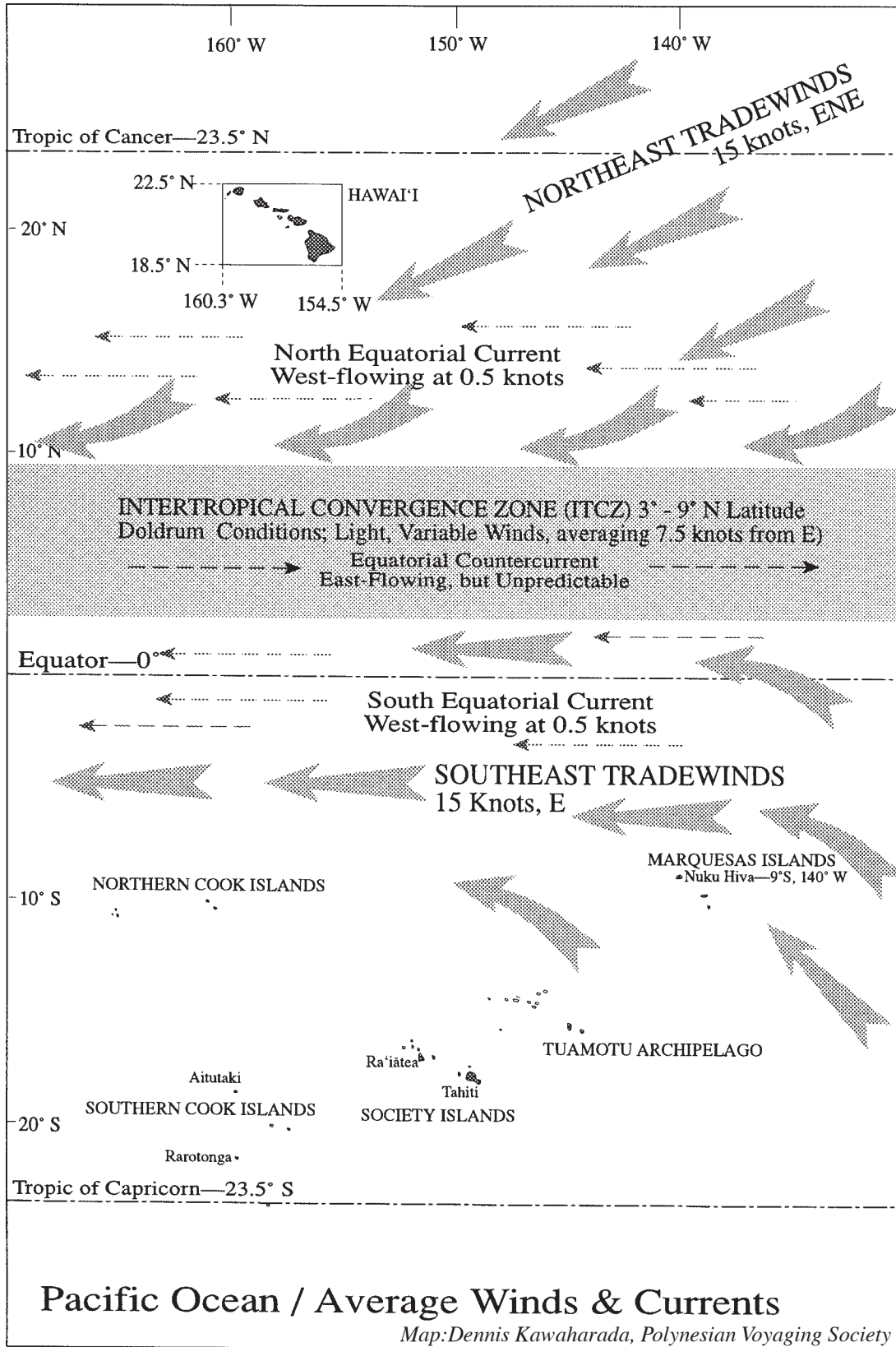
In this zone equatorial countercurrent flows eastward, between the two west-flowing equatorial currents. This countercurrent is formed as the water pushed west by the trade winds flows back east parallel to the equator. Like other conditions in this zone, the countercurrent is sporadic and shifting.

Northeast Tradewind Belt

The winds here are from the east north east (ENE), more reliable in the summer than in the winter. The northeast trade winds drive the north equatorial current, which flows westward.

Heading Home

As you navigate through these major current and wind zones, you aim *Hōkūleʻa* to the windward side of the Hawaiian Islands. That way, you



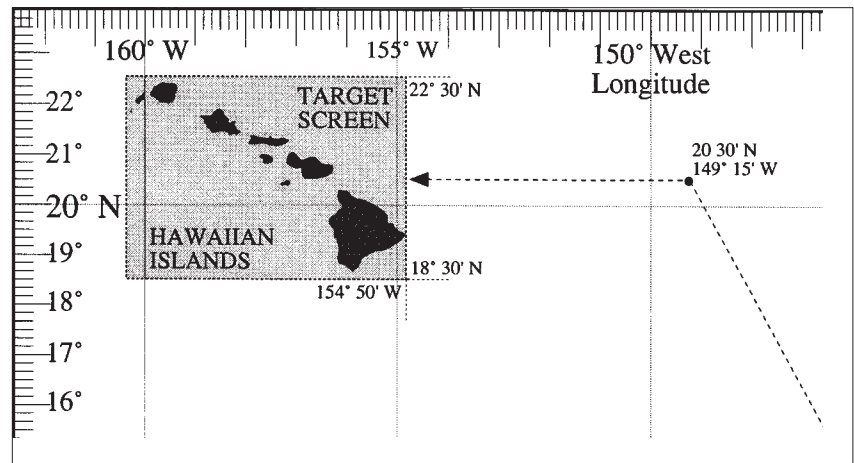


will have the wind with you as you approach land and use landmarks to help guide *Hōkūle‘a* to Hāna.

When you plan your reference course, you set an area called a “target screen,” which is the area in which the highest points of the destination islands will be visible. During the voyage, as *Hōkūle‘a* approaches the middle latitude of this target screen (from the windward side of course!) you make your final major course adjustment, turning west toward the Hawaiian Islands. Turning at the middle latitude of the target screen leaves the most margin for error in estimating the latitude or staying on course in approaching the islands.

You and the crew of *Hōkūle‘a* will also rely on other observations to assist you in finding land. For example, seabirds such as the *manu o Kū* (fairy tern or *Gygis alba rothschildi*) and the *noio* (black noddy or *Anous minutus malanogenys*) may indicate the presence of low-elevation islands even before the voyagers can see land. The average range of these seabirds is about 60 miles around each island.

As you develop your sailing plan summary, you will learn how to plan a course to navigate through the wind and current zones to reach your final destination . . . Maui.



Map section showing target screen and course turning for home at mid-latitude. (Map: Dennis Kawaharada, Polynesian Voyaging Society)



From Nuku Hiva to Hawai'i: Charting a Course

Despite the hospitality of your Nuku Hivan hosts, the crew of *Hōkūle'a* is anxious to begin the journey home to Maui. As wayfinder, you are nearing the end of your preparations. You have already mapped a reference course based on average wind and current conditions you are likely to encounter along the way. Now, while the rest of the crew is provisioning the canoe, you must create a more detailed summary of your sailing plan for this trip, using the information and maps given below. The remaining work is divided into three tasks.

Assignment

Work with your team members to complete all three tasks quickly and accurately.

Task #1: Check the Weather

The crew is anxious to return home, but you need to make sure this is a good time of year to be sailing between Nuku Hiva and Hawai'i. Use the information below to determine the safest months in which to make this voyage and explain your reasoning.

- Hurricane seasons: Hurricanes are tropical cyclones with a wind speed exceeding 64 knots. They form in the warm waters of the equator and are steered away from the equator by surface winds. Chances of surviving a hurricane on a voyaging canoe are minimal, so hurricanes must be avoided.
 - The hurricane season in the southern hemisphere is December-February.
 - The hurricane season in the northern hemisphere is June-September.
- Winter storms: There is a greater likelihood of encountering storms during the winter than at other times of the year.
 - Winter season in the southern hemisphere is June-September.
 - Winter season in the northern hemisphere is December-March.

The safest month or months for Hōkūle'a to sail:



Task #2: Confirm Your Target Screen

You have already set a “target screen.” This is the general area that you’ll be trying to reach on your voyage. Within this area, you’ll be able to sight land. Once you sight land, you will use familiar landmarks to find your way to Hāna. Double-check how close to some of the major landmarks you would need to be in order to see them. In order to calculate these distances, you will need the following information:

- The formula for calculating the range for sighting land: Square root of h + square root of H = distance in nautical miles from which an object can be seen. (h = height above sea level of the observer in feet, H = height above sea level of the object in feet.)
- The deck of *Hōkūle‘a* is about four feet high.
- The elevations of some these landmarks are:
 - Hawai‘i: Mauna Kea, 13,796 feet
 - Maui: Haleakalā, 10,023 feet
 - Kauai: Kawaikini, 5243 feet

Your answers:

Sighting distance from *Hōkūle‘a* to Mauna Kea:

Sighting distance from *Hōkūle‘a* to Haleakalā:

Sighting distance from *Hōkūle‘a* to Kawaikini:

Given the average range of seabirds such as the *noio* and *manu o Kū*, would you be likely to see these landmarks first, or would seabirds likely give away the presence of islands nearby first? Explain.



Task #3: Finalize Your Sailing Plan

Using the reference course you have already charted, the currents map (from the Student Page “Navigating the Currents”), and the information provided below, fill in the blanks in the sailing plan for the trip from Nuku Hiva to Hāna, Maui.

Information You Will Need

- The sailing plan is broken up into segments corresponding to each of the different wind and current zones you’ll cross during the voyage:

Southeast Trade Wind Belt (Nuku Hiva to 3°N latitude)

Average wind speed: 15 knots (nautical miles per hour) from the east

Average current speed: West-flowing at .5 knots

Intertropical Convergence Zone (3°N latitude to 9°N latitude)

Average winds: Doldrum conditions—light and variable winds averaging 7.5 knots from the east

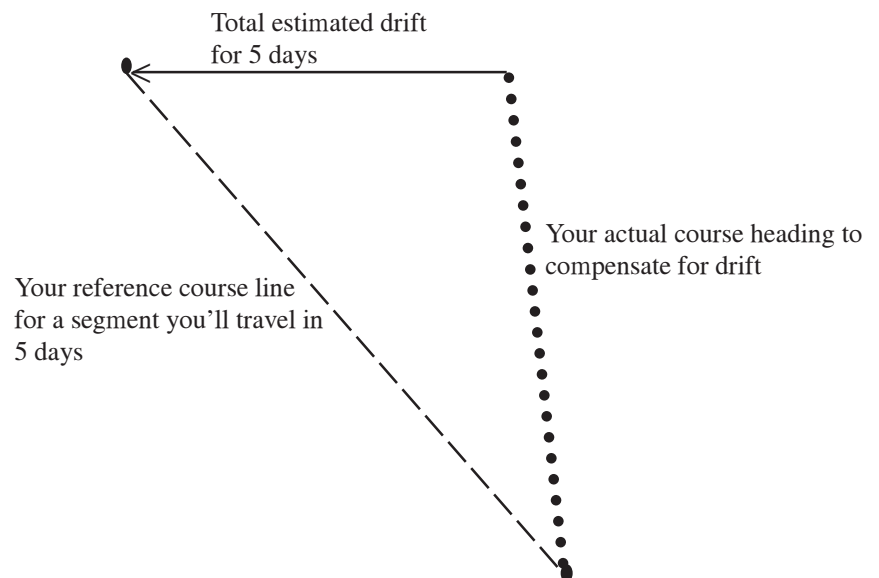
Average current: Unpredictable, cannot be factored into your course line

Northeast Trade Wind Belt (9°N latitude to Hawai‘i)

Average wind speed: 15 knots from the ENE

Average current speed: West-flowing at .5 knots

- The average speed of *Hōkūle‘a* is 1/3 the wind speed. Wind speed is measured in knots. A knot is one nautical mile per hour.
- All distances are measured in nautical miles. One nautical mile = 6076 feet = one minute of latitude or longitude. Latitude and longitude are measured in degrees (°) and minutes (′). There are 60 minutes in a degree longitude or latitude.
- When you plot the actual heading, factoring in the total distance and direction of drift due to the current for the entire segment, you’ll need to plot the distance and direction of the drift for the entire segment and adjust the actual heading accordingly. For example:





Sailing Plan Summary *Nuku Hiva to Hāna, Maui*

Write your sailing plan below. Include your calculations.

Segment 1: In the Southeast Tradewinds

Latitudes: _____ to _____

Average canoe speed:

Average distance traveled per day:

Total distance to be traveled: 710.6 miles

Total number of days for this segment:

Expected total distance and direction of drift due to the current:

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map (p. 27).



Segment 2: In the Intertropical Convergence Zone

Latitudes: _____ to _____

Average canoe speed:

Average distance traveled per day:

Total distance to be traveled: 368.1 miles

Total number of days for this segment:

Expected total distance and direction of drift due to the current:

Heading: NNW

Determine the actual heading with current factored in and draw it on the reference course map (p. 27).



Segment 3: In the Northeast Tradewinds

Latitudes: _____ to _____

Average canoe speed:

Average distance traveled per day:

Total distance to be traveled: 785.3 miles

Total number of days for this segment:

Expected total distance and direction of drift due to the current:

Heading: Between N by W and NNW

Determine the actual heading with current factored in and draw it on the reference course map (p. 27).



Segment 4: Westward to Hāna

Latitudes: 20° 30' N to 20° 45' N

Average canoe speed based on wind speed:

Expected HOURLY distance and direction of drift due to the current:

Expected actual performance of the canoe (add speed based on wind and current together):

Average distance traveled per day:

Total distance to be traveled: 405.3 miles

Total number of days for this segment:

Expected total distance and direction of drift due to the current:

Heading: W

Determine the actual heading with current factored in and draw it on the reference course map (p. 27).

