[music]

[00:00:16] Jordan: Hi, I'm Jordan.

[00:00:17] Kit: And I'm Kit.

[00:00:18] Jordan: Welcome to Starry Time, where Stars plus Lines

[00:00:22] Kit: equals Stories.

[00:00:23] Jordan: Welcome to Season 3, In the Wilds. We are back with a double feature for y'all for Week 1.

[00:00:31] Kit: In this season, we'll be discussing a range of constellations found, well, in the wild. For those of you joining us for the first time, welcome. This is a podcast where we discuss the astronomy, mythology, pop culture,-

[00:00:43] Jordan: A very broad definition of pop culture.

[00:00:46] Kit: -of one of the IAU-recognized constellations each month. Our previous seasons have included the Zodiac constellations and a set of constellations that we called Quests and Curses.

[00:00:57] Jordan: Quests and Curses.

[00:00:59] Kit: Be sure to check those out if you haven't already.

[00:01:02] Jordan: This week we're coming in strong with two cosmic background episodes. One on Ursa Minor, the Little Bear, and this one, of course, on Ursa Major, the Big Bear.

[00:01:13] Kit: Ursa Major lives up to its name, coming in at 1280 square degrees, making it the third largest IAU constellation in the night sky.

[00:01:25] Jordan: Number one is Hydra, which we haven't covered yet, and Virgo is number two, which we covered back in Season 1 of our Zodiac Constellations.

[00:01:34] Kit: Ursa Major is also one of Ptolemy's great-

[00:01:37] Jordan: great-great-great-great-great-great-great.

[00:01:40] Kit: -48 constellations, but as we'll discuss in our Myths and Retcons episode, this constellation has a very, very long history, and Ptolemy was certainly drawing upon prior Egyptian, Babylonian, and Assyrian astronomy.

[00:01:53] Jordan: All right, we know this is a large and iconic constellation, but does it look like a big bear, Kit? What were your first impressions?

[00:02:02] Kit: I think this is a good question, because I think most people when

they think of Ursa Major, they actually just think of the Big Dipper, but if you look at the official star map from the IAU, the Big Dipper is only like a quarter of the drawing, and the full drawing, it has some animal qualities. If I look left to right, I can kind of see a deer, even though the bear is actually going, I think, right to left, in which case, if I go right to left, I'm further away from deer, because we don't really think of bears or deers as having long tails-

[00:02:40] Jordan: Yes.

[00:02:40] Kit: -but if you look in that direction, it certainly seems to have a tail, but there's something animal creature-like here. How about you, Jordan, what were your first impressions of this?

[00:02:49] Jordan: It all depends which way you're looking at it. I definitely agree with you on the left to right. It looks like some sort of galloping animal, very small head, like you said, like a deer or an antelope or something. If you look at it the other way, from right to left, which is how it's supposed to be looked at, to me it just looks like a rat or a lizard or like a lizard rat.

[00:03:12] Kit: Really?

[00:03:13] Jordan: It's kind of got a long pointy head like a rat would have and a long tail like a rat would have, but the legs kind of look like little lizard legs, but yes, it looks like an animal. I can make out a body and legs. Bear wouldn't be my first guess.

[00:03:27] Kit: Probably no one really needed our first impressions of this [laughs], mostly just because I think most people are familiar with the Big Dipper asterism, but we're going to do our due diligence. We're going to get technical, for everyone who's trying to find Ursa Major in the night sky. I will note that many star hopping guides take finding Ursa Major as like for granted. They'll start with like, "Find Ursa Major," so shame on them.

[00:03:54] Jordan: Shame. Shame.

[00:03:54] Kit: [laughs] What if you can't find it? But Ursa Major is neighbored by eight constellations. To the northish, we have Draco and Camelopardalis. To the eastish, we have Boötes and Canes Venatici.

[00:04:09] Jordan: Venatici.

[00:04:11] Kit: [laughs] We'll come back to that one one day. To the southish, we have Coma Berenices and Leo Minor and Lynx.

[00:04:18] Jordan: To be more precise, we love to get a little technical here. Ursa Major has a right ascension of about 10 hours and 40 minutes and 56 degrees north declination.

[00:04:32] Kit: It's again a Northern Hemisphere constellation that can be seen between positive 90 and negative 30 degrees latitude, but it's best seen at night in April and May in the Northern Hemisphere.

[00:04:43] Jordan: You may remember from Ursa Minor, which is best seen in June. This is a little bit earlier.

[00:04:48] Kit: Mm-hmm. Let's talk about stars.

[00:04:51] Jordan: Mm-hmm.

[00:04:52] Kit: This constellation is comprised of about 20 main stars, seven of which are part of the Big Dipper asterism.

[00:05:00] Jordan: Unfortunately, despite his very strong start with Ursa Minor, our number one, in our heart's favorite, astronomer/lawyer did not provide the brightest star the Alpha designation. Alpha Ursae Majoris, also known as Dubhe. [pronunciation of Dubhe]

[00:05:18] Kit: [pronunciation of Dubhe]

[00:05:20] Jordan: [pronunciation of Dubhe]. It's actually the second brightest star in the constellation and the 34th brightest star in this constellation.

[00:05:28] Kit: Okay, so it's kind of bright. So what? Bayer called the brightest star Beta Ursae Majoris or what?

[00:05:34] Jordan: No, Kit. If only.

[00:05:35] Kit: Oh, no.

[00:05:36] Jordan: If only. We gave him a lot of credit in Episode 1. Maybe that was misplaced. The brightest star in this constellation has a visible magnitude of 1.77 and the designation of Epsilon Ursae Majoris.

[00:05:52] Kit: Oh, no. Ouch. Bayer, that is mmm.

[00:05:56] Jordan: Epsilon Ursae Majoris is known by the name Alioth, Alioth that comes from an Arabic phrase, meaning the sheep's fat tail.

[00:06:05] Kit: Excuse me?

[00:06:06] Jordan: Kit, translation.

[00:06:08] Kit: [laughs]

[00:06:09] Jordan: It's not just the sheep's tail, it's not just the fat tail, it's the sheep's fat tail. Translation.

[00:06:13] Kit: Do sheeps even have fat tails?

[00:06:17] Jordan: Yes, of course they do. Wait till we get to Creature Corner Sheeps.

[00:06:20] Kit: Okay. I guess sheeps do have more tail than I realized.

[00:06:27] Jordan: Alioth is considered the 33rd brightest star in the night sky and it is one of the 57 navigational stars that we discussed briefly in our Cosmic Background of Perseus episode. It's located in the middle of the handle of the Dipper part of the asterism. The star is located 81 light years from the solar system and has a spectral type of A1p.

[00:06:52] Kit: Ooh, new spectral type, okay. I don't think we've talked about-- We've talked about A-type stars and B type, but I don't think we've talked about the Ap or Bp stars.

[00:07:02] Jordan: New season, Kit. New rules. Let's dive in. The "p" in these spectral types stands, guess what? For peculiar. Meaning, in an astronomical sense, that they have chemical peculiarities with higher than expected levels of strontium, chromium, europium, and sometimes praseodymium and neodymium. I think now you're just making up some of these words to see if I'll say them.

[00:07:27] Kit: [laughs] Yes. You'll notice that anytime there's a string of words, I'm like, "Well, I think Jordan can tell us about--" We have talked a little bit about this idea of chemically peculiar stars, and it's basically, just again, this idea that they have more or different amounts of certain metals than we would expect. I guess in this case we're just talking about A or B-type stars, which are those hot white or bluish white stars that are more massive than our G-type Sun, but they tend to rotate more slowly, these particular ones, because they have peculiar composition, so they rotate more slowly, they have stronger magnetic fields than their non-chemically peculiar counterparts.

[00:08:08] Jordan: In Alioth's case, the spectral lines of the star seem to change over a period of around five days, and there are bands of chromium at right angles to the equator.

[00:08:20] Kit: Hmm, this is a very neat and strange star.

[00:08:23] Jordan: One might even call it a bit peculiar. Let's move on to our segment Bayer's Variable Star, where we move through the Greek alphabet to learn more about another Bayer-designated star in the night sky. What should we know about Gamma Ursae Major, Kit?

[00:08:41] Kit: Gamma Ursae Majoris is also known as Phecda, and it's from an Arabic phrase meaning "thigh of the bear," so no sheep anymore. Good. This star is in the bottom corner of the Dipper asterism and has an apparent magnitude of 2.44. Although the star is located 82 light years from the Solar System, it's only 8.55 light

years from Zeta Ursae Majoris and Alcor, a star designated as Eta Ursae Majoris, and only 11 light years from Beta Ursae Majoris. If we were on Gamma Ursae Majoris and we were looking out into the sky, the Beta Star, Beta Ursae Majoris, would look like Sirius looks like to us, according to Dr. Jim Kaler's website.

[00:09:29] Jordan: For reference, the closest star to the Sun is Proxima Centauri, and it is located only 4.2 light years from the Solar System. It will take Voyager 1 about 73,000 years, give or take, to reach Proxima Centauri, and if we could travel at 10% the speed of light, which seems very unlikely with current technology--

[00:09:54] Kit: Yes, the fastest tech that we've had that's ever been made is NASA's Parker Solar Probe, and that's expected to, at peak speed, go about 0.064% the speed of light.

[00:10:10] Jordan: Yes, way faster than that. It would take about 44 years to get to Proxima Centauri.

[00:10:17] Kit: Yes, I think what's interesting about Gamma Ursae Majoris is that it's so close together to these other stars, at least astronomically speaking. Phecda is an A-type star. It's 2.6 times the mass of the Sun and three times the Sun's radius. It's also believed to have a K-type main sequence companion that causes it to sort of wobble a little bit in its orbit, but I think probably the most interesting thing about this star is that it's actually an Ae-type star, meaning it has a hydrogen emission line in its spectrum, likely due to being in an envelope or a cloud of spinning gas. Usually stars like Phecda are hotter B-type stars, so there's actually relatively few Ae-type stars, while Be-type stars are much more common.

[00:11:03] Jordan: Gamma Ursae Majoris, it's a variable star. You never know what you're going to get. But this one was a winner.

[music]

[00:11:20] Kit: Welcome back. This segment is called Gold Star. In this segment, we alternate picking the star or space object in our constellation of the month that captures our mind, our heart, and our souls. What was your pick this month, Jordan?

[00:11:37] Jordan: Kit, this is one of the most famous constellations, and it does not lack for options. There are seven Messier objects in this constellation, including the iconic Pinwheel Galaxy and the Owl Nebula, and a number of stunning lenticular and spiral galaxies also are found in this constellation.

[00:11:58] Kit: I'll be posting so many space pictures on our social this week, so be sure to follow us. We're at at starrytimepod on the U niverseodon server on Mastodon, because, wow, these are all just beautiful.

[00:12:11] Jordan: But in the end, I tried my best to narrow it down just to a runner-up and a winner.

[00:12:16] Kit: All right, I'm ready.

[00:12:17] Jordan: My runner-up is I Zwicky 18.

[00:12:21] Kit: Wow, what a name.

[00:12:24] Jordan: Yes, you like that?

[00:12:25] Kit: Yes.

[00:12:25] Jordan: I Zwicky 18.

[00:12:27] Kit: Yes.

[00:12:27] Jordan: For sure. It's named after a Swiss astronomer whose name gets better. His full name is Fritz Zwicky, and he was born in 1898 in Bulgaria and died in 1974. He emigrated to the United States in 1925 and had an office near Dr. Robert Oppenheimer.

[00:12:47] Kit: Oh dear, oh dear.

[00:12:49] Jordan: He coined the term supernova and did do important work related to dark matter, gravitational lenses, and numerous other areas which maybe can wait for a future asterism.

[00:12:59] Kit: Yes, there's a lot of stuff on his Wiki for sure.

[00:13:04] Jordan: Most importantly, his Wiki says that he was remembered as, and I quote, "A genius and a curmudgeon."

[00:13:11] Kit: Oh, wow, I love that. I wish that could go on my gravestone.

[00:13:17] Jordan: Fritz Zwicky is **[unintelligible 00:13:17].** Fritz Zwicky is brat.

[00:13:19] Kit: Brat. [laughs]

[00:13:21] Jordan: All right. This wasn't my top choice, but I Zwicky 18 was part of the 1930s photographic surveys of galaxies that Dr. Zwicky conducted. It is a blue compact dwarf galaxy, which means it's blue and hue and small in size. It is also a starburst galaxy, meaning it has a more than typical star formation than observed in other galaxies.

[00:13:43] Kit: Yes, starburst galaxies are cool. Basically, for example, the Milky Way has a formation rate of about three solar masses a year, and these starburst galaxies can have up to 100 solar masses a year.

[00:13:56] Jordan: This particular galaxy was a bit of a mystery for a while, but it seemed to be very close and it seemed to be really young, only about 500 million years old was the initial--

[00:14:08] Kit: Young astronomically speaking.

[00:14:10] Jordan: However, later work with the Hubble Space Telescope showed us it is actually at least 1 billion or 10 billion years old, so relatively normal age and also a bit further away than we initially thought. This galaxy is still a bit of a mystery. It is 59 million light years away, but despite being pretty old, it does have a lot of active star formation. It seems to be an open question as to why it is still forming stars now.

[00:14:40] Kit: That is intriguing, especially compared to the Gold Star from Ursa Minor. These old, very dim galaxies and formations. Yes, intriguing.

[00:14:50] Jordan: This is the reverse. There's actually a lot of really cool stuff about this galaxy, including the fact that it is creating population 3 stars which are extremely "metal-poor." They are comprised of helium and hydrogen and are thought to be the kinds of stars that we would have seen in the very early days of the universe.

[00:15:09] Kit: The idea, just sort of in background, of stellar populations is that we went from population 3 stars to population 2 stars which are metal-poor, to population 1 which are metal-rich. Our Sun, for example, is one of these metal-rich population 1 stars. Yes, lots of new stuff here. Cool stuff, so why didn't it win the Gold Star?

[00:15:30] Jordan: I mean, it definitely won the Brat Star.

[00:15:32] Kit: Yes. [laughs]

[00:15:33] Jordan: I Zwicky 18. I'll give it that, but ultimately, I had to tip my hat here to an absolutely iconic image that came from the constellation Ursa Major. It may or may not have been your computer background for 10, 15-- for quite many, many years.

[00:15:54] Kit: Well, I know it can't be Spock, so it must be the Hubble Deep Field.

[00:15:59] Jordan: Ding-ding-ding-ding-ding.

[00:16:00] Kit: Yes.

[00:16:01] Jordan: The Hubble Deep Field was constructed using images covering 2.6 arc minutes near Delta Ursae Majoris.

[00:16:11] Kit: Amazing.

[00:16:12] Jordan: This was an image constructed using 342 exposures taken with Hubble Space Telescope's Wide field and Planetary Camera too over 10 days starting on December 19th, 1995. This image has some 3,000 objects which are nearly all galaxies.

[00:16:31] Kit: For putting this into context, 2.6 arc minutes is 23 millionths of the night sky, 1/12th the width of the Moon, the angular size of a tennis ball at a distance of 328 feet. Small.

[00:16:49] Jordan: There's just a ton of galaxies in this tiny, tiny, tiny, tiny, tiny area of space. The image is an essential piece of our understanding the early universe and delivered on the promise of the Hubble Space Telescope, which included high optical resolution above the Earth's atmosphere. It wasn't the first space telescope, but it was the biggest and has an area of instruments that hadn't been found on other space telescopes, and guess what? Hubble Space Telescope is still working though it was launched all the way back in 1990.

[00:17:22] Kit: I love the Hubble Space Telescope and the Hubble Deep Field. The Hubble Deep Field makes me want to cry every time I see it. Anytime I really think about it, it's really, yes, it's amazing, and there have been a series of additional Deep Field pictures made over the years, including the Ultra Deep Field in 2004, the Extreme Deep Field in 2012, and I'll, of course, be posting those over on our socials. I really can't imagine a better pick for Gold Star, but certainly, I Zwicky 18 was a contender.

[00:17:53] Jordan: "A genius and a curmudgeon," but it wasn't the Gold Star.

[music]

[00:18:03] Jordan: That brings us to the end of our exploration of the cosmic background of the constellation Ursa Major, the Great Bear. Next week we'll combine Ursa Major and Ursa Minor for our Myth Retelling and Retconstellation.

[00:18:19] Kit: This has been Kit.

[00:18:20] Jordan: And Jordan.

[00:18:21] Kit: Sisters who love stars and stories.

[00:18:24] Jordan: And we'll see you next time-

[00:18:26] Kit: -on Starry Time.

[music]