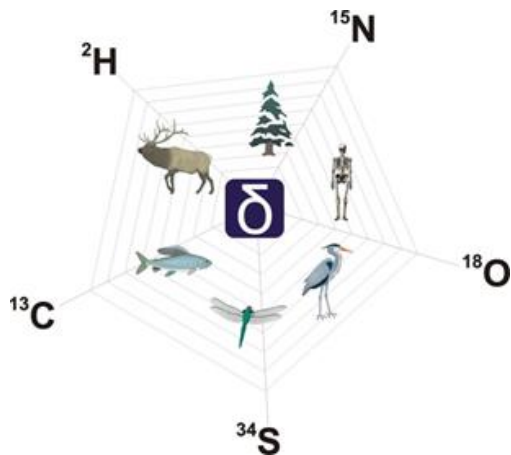


# Using stable isotopes to trace origins of shark and ray tissues?

Dr. Keith A. Hobson  
Science and technology Branch  
Environment and Climate Change Canada  
Saskatoon, SK

*Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)  
Workshop on Combating Illegal Trade of Wildlife Species: Sharks and Stingrays.*



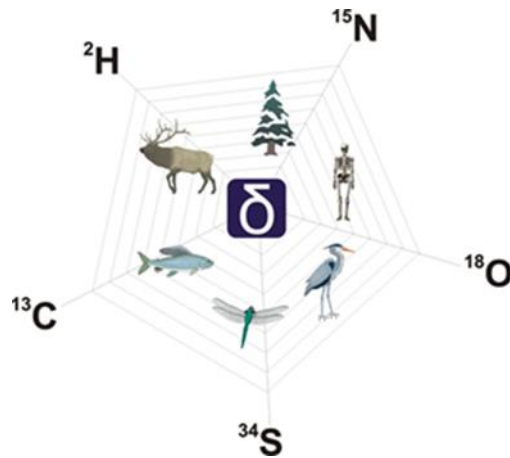
3 May 2023

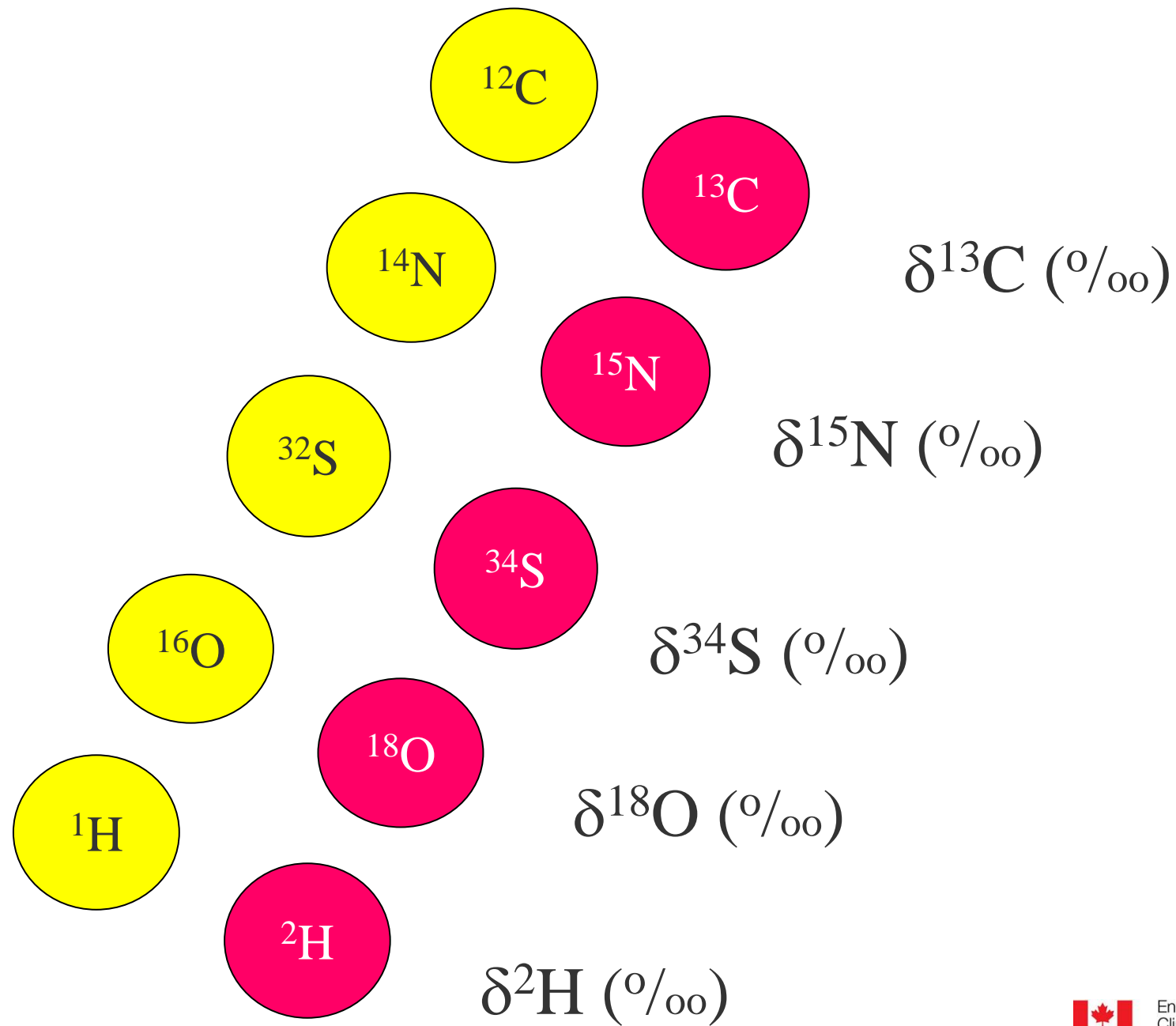


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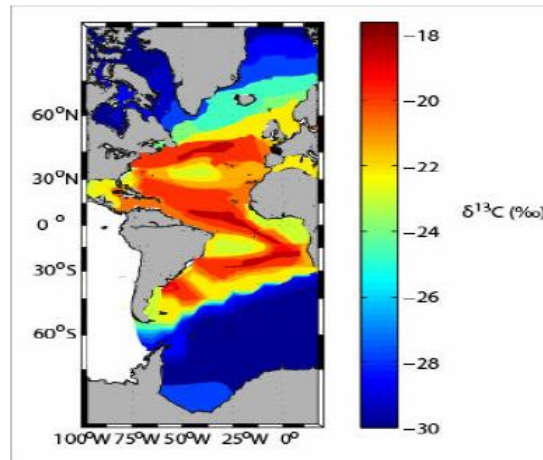
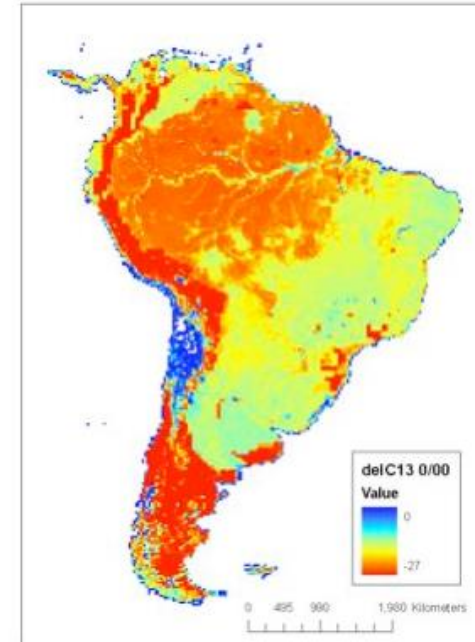
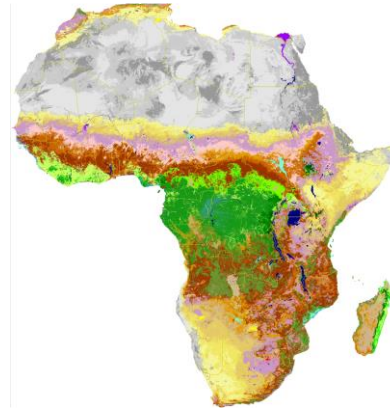
# Problem: Forensic determination of animal origins?

- Need INTRINSIC markers
  - Genetics
  - Trace elements
  - Stable isotopes





# Biogeochemical processes result in isotopic patterns or “isoscapes” in terrestrial and marine biomes...





# Marine Isoscapes

## Isotopic Tracking of Marine Animal Movement

Clive N. Trueman and Katie St John Glew  
University of Southampton, Southampton, United Kingdom

- Less well developed but we are progressing! (mainly C,N)....

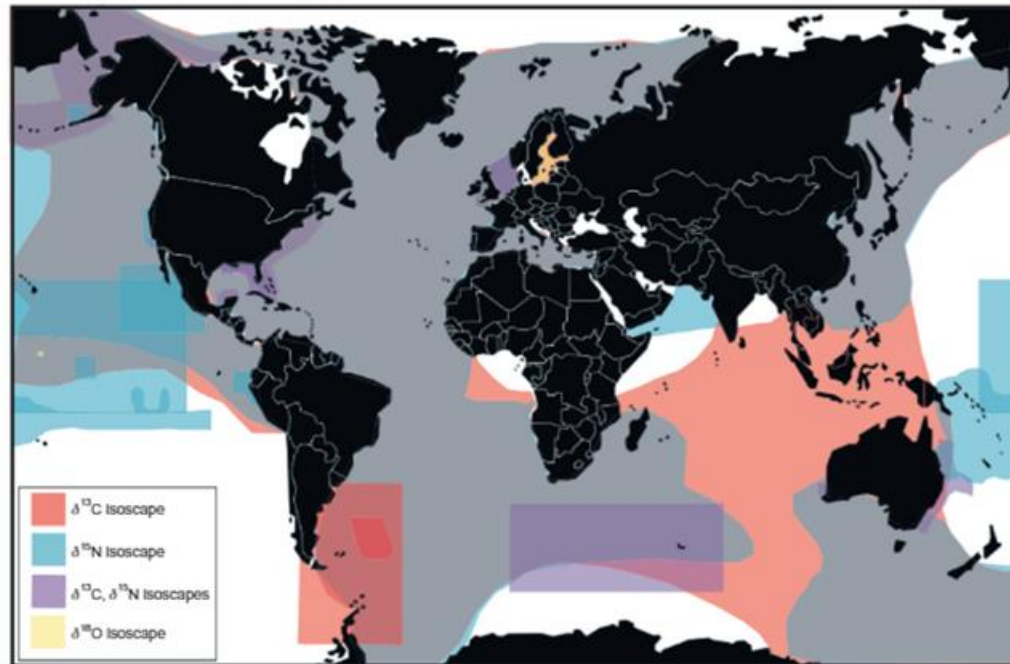
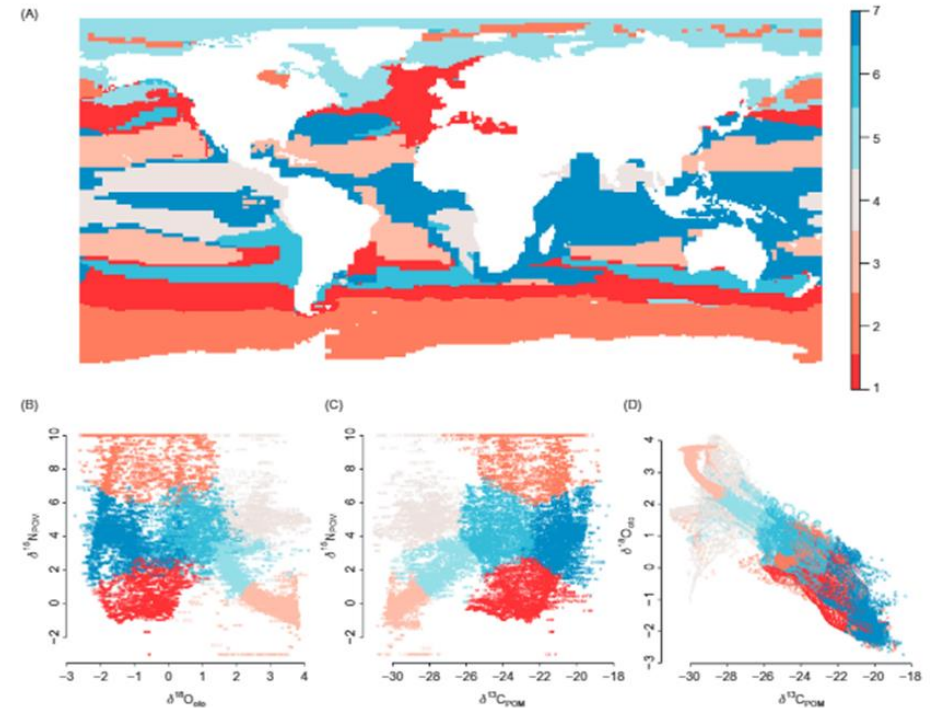


FIGURE 6.1 Areas of the global ocean for which isoscape models have been published (citations and details in Table 6.1).



# Many examples of marine turtle tracking to origins:

Vol. 613: 217–245, 2019  
<https://doi.org/10.3354/meps12889>

MARINE ECOLOGY PROGRESS SERIES  
Mar Ecol Prog Ser

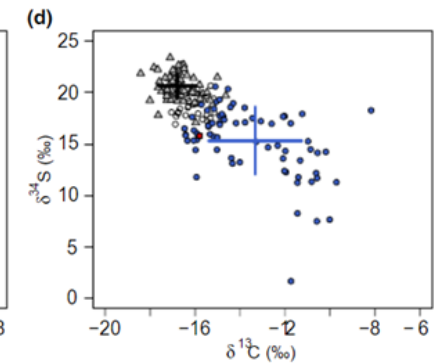
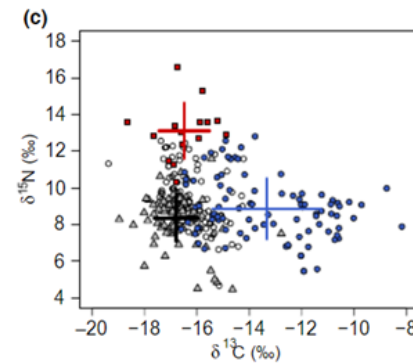
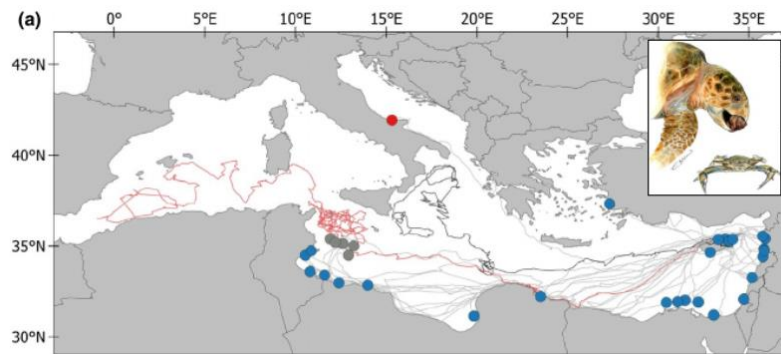
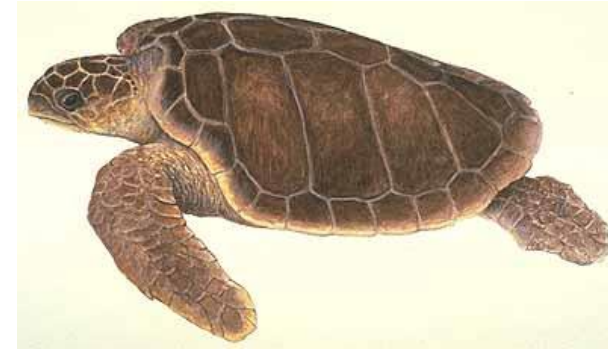
Published March 21



REVIEW

## Global review and inventory: how stable isotopes are helping us understand ecology and inform conservation of marine turtles

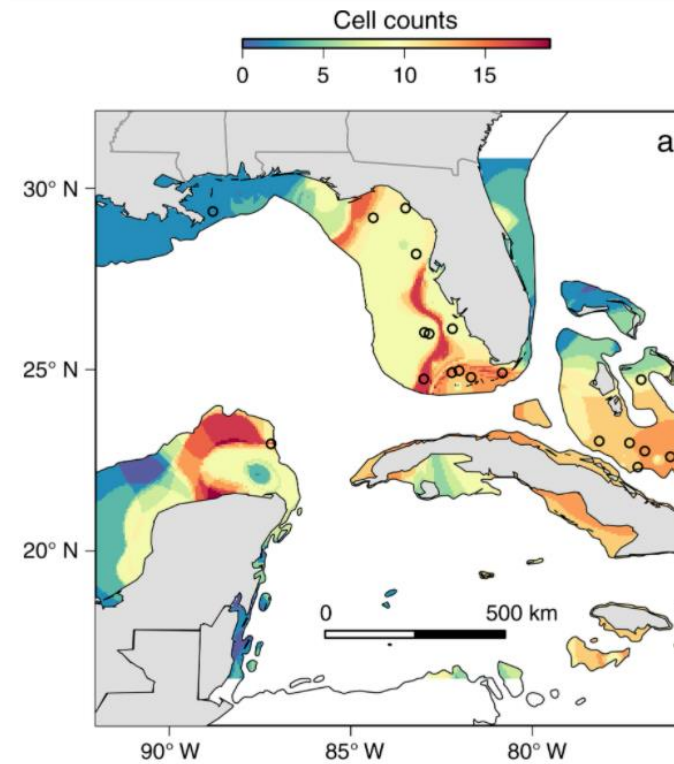
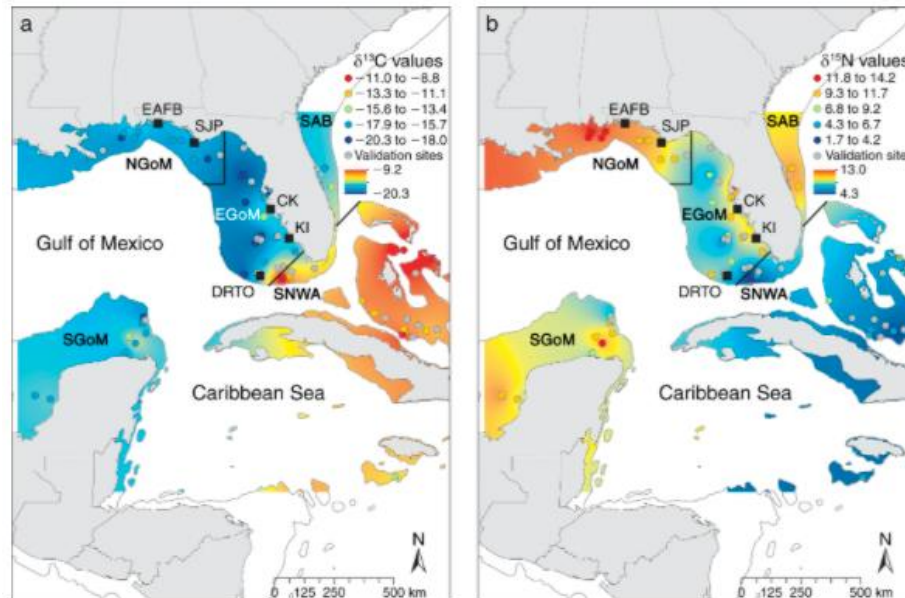
Julia C. Haywood<sup>1,2,\*</sup>, Wayne J. Fuller<sup>3</sup>, Brendan J. Godley<sup>1,4</sup>, Jamie D. Shuttler<sup>5</sup>, Stephen Widdicombe<sup>2</sup>, Annette C. Broderick<sup>1</sup>



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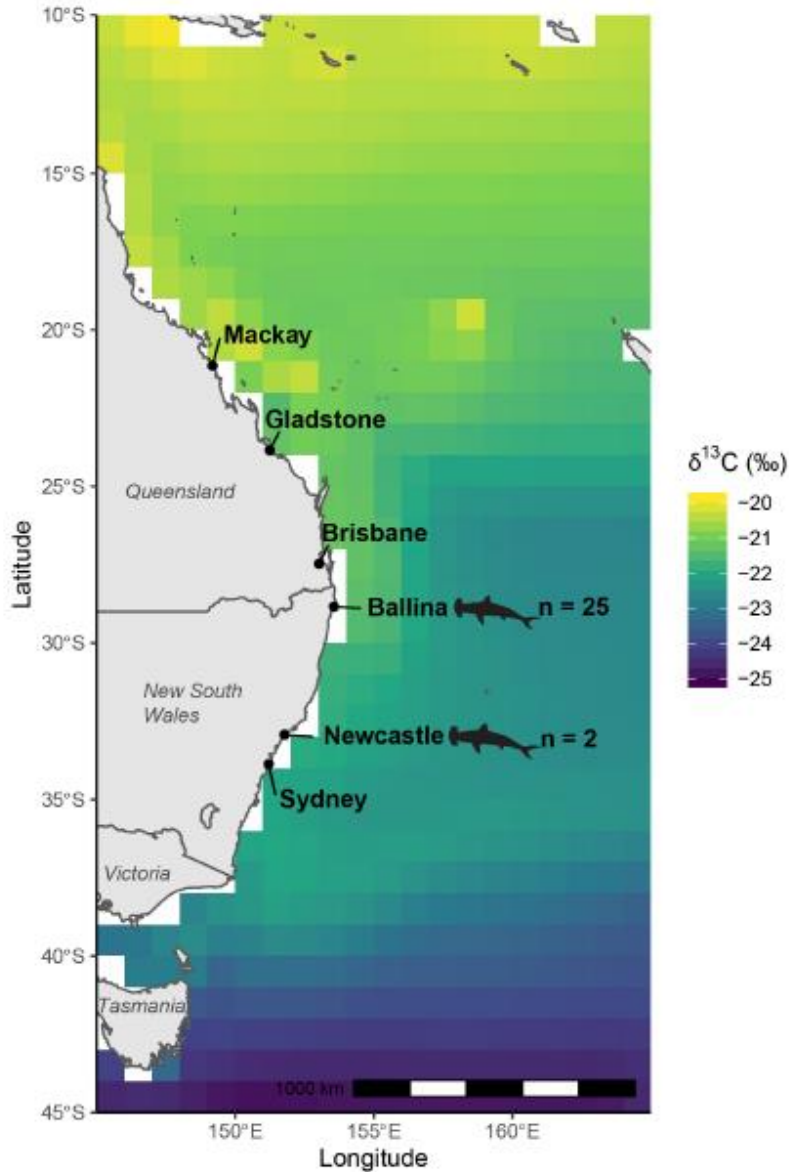
## Determining origin in a migratory marine vertebrate: a novel method to integrate stable isotopes and satellite tracking

HANNAH B. VANDER ZANDEN,<sup>1,2,11</sup> ANTON D. TUCKER,<sup>3</sup> KRISTEN M. HART,<sup>4</sup> MARGARET M. LAMONT,<sup>5</sup>  
IKUKO FUJISAKI,<sup>6</sup> DAVID S. ADDISON,<sup>7</sup> KATHERINE L. MANSFIELD,<sup>8</sup> KATRINA F. PHILLIPS,<sup>9</sup> MICHAEL B. WUNDER,<sup>10</sup>  
GABRIEL J. BOWEN,<sup>2</sup> MARIELA PAJUELO,<sup>1</sup> ALAN B. BOLTEN,<sup>1</sup> AND KAREN A. BJORNDAI,<sup>1</sup>





# For Sharks:



## Predicting Geographic Ranges of Marine Animal Populations Using Stable Isotopes: A Case Study of Great Hammerhead Sharks in Eastern Australia

Vincent Raoult<sup>1\*</sup>, Clive N. Trueman<sup>2</sup>, Kelsey M. Kingsbury<sup>3</sup>, Bronwyn M. Gillanders<sup>3</sup>, Matt K. Broadhurst<sup>4</sup>, Jane E. Williamson<sup>5</sup>, Ivan Nagelkerken<sup>3</sup>, David J. Booth<sup>6</sup>, Victor Peddemors<sup>7</sup>, Lydie I. E. Couturier<sup>8</sup> and Troy F. Gaston<sup>1</sup>

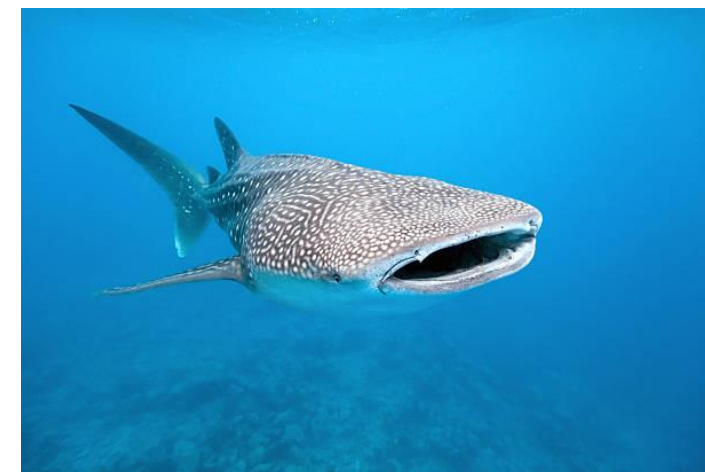
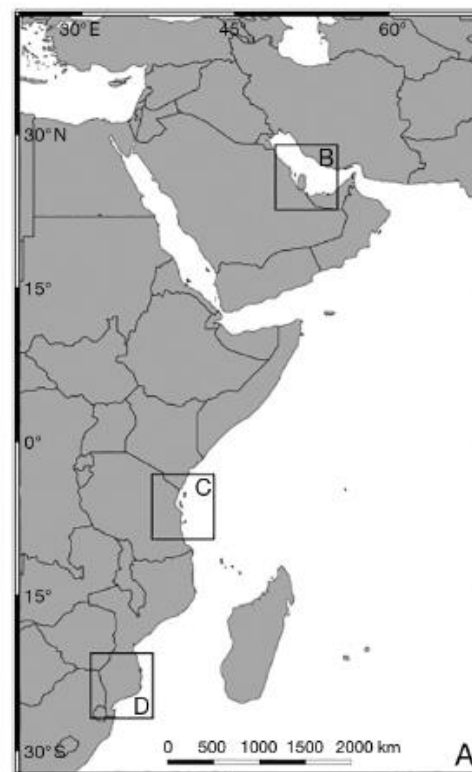
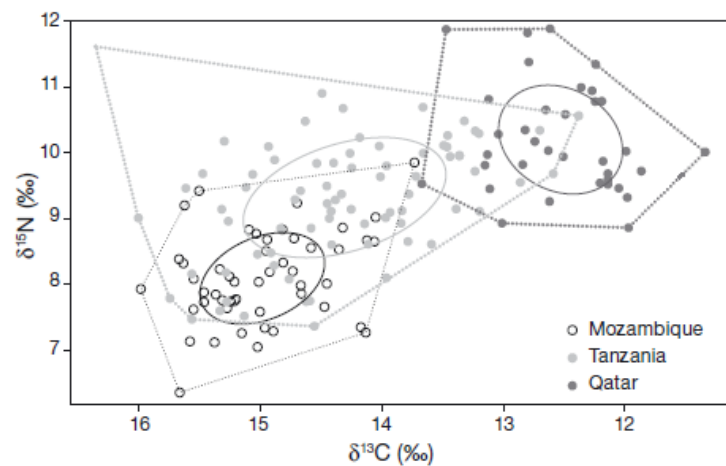
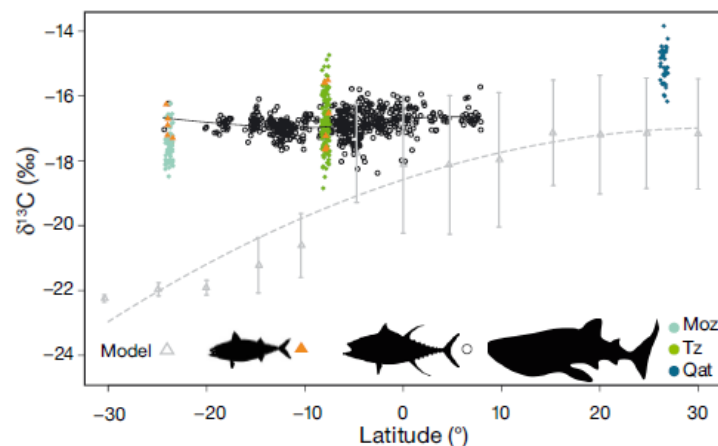
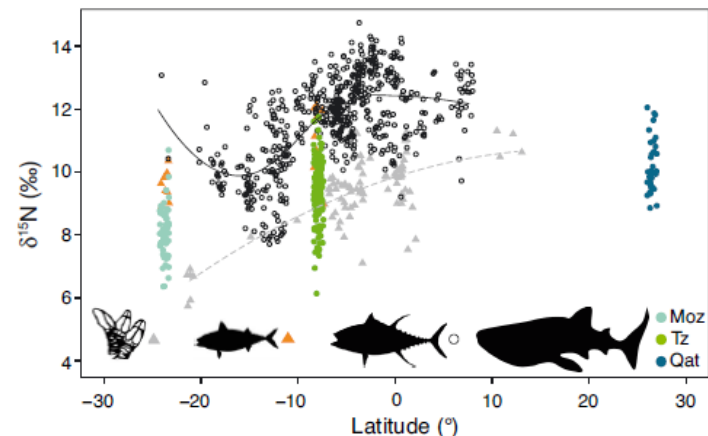






## Limited latitudinal ranging of juvenile whale sharks in the Western Indian Ocean suggests the existence of regional management units

Clare E. M. Prebble<sup>1,2,\*</sup>, Christoph A. Rohner<sup>2</sup>, Simon J. Pierce<sup>2</sup>, David P. Robinson<sup>3</sup>,  
Mohammed Y. Jaidah<sup>4</sup>, Steffen S. Bach<sup>5</sup>, Clive N. Trueman<sup>1</sup>



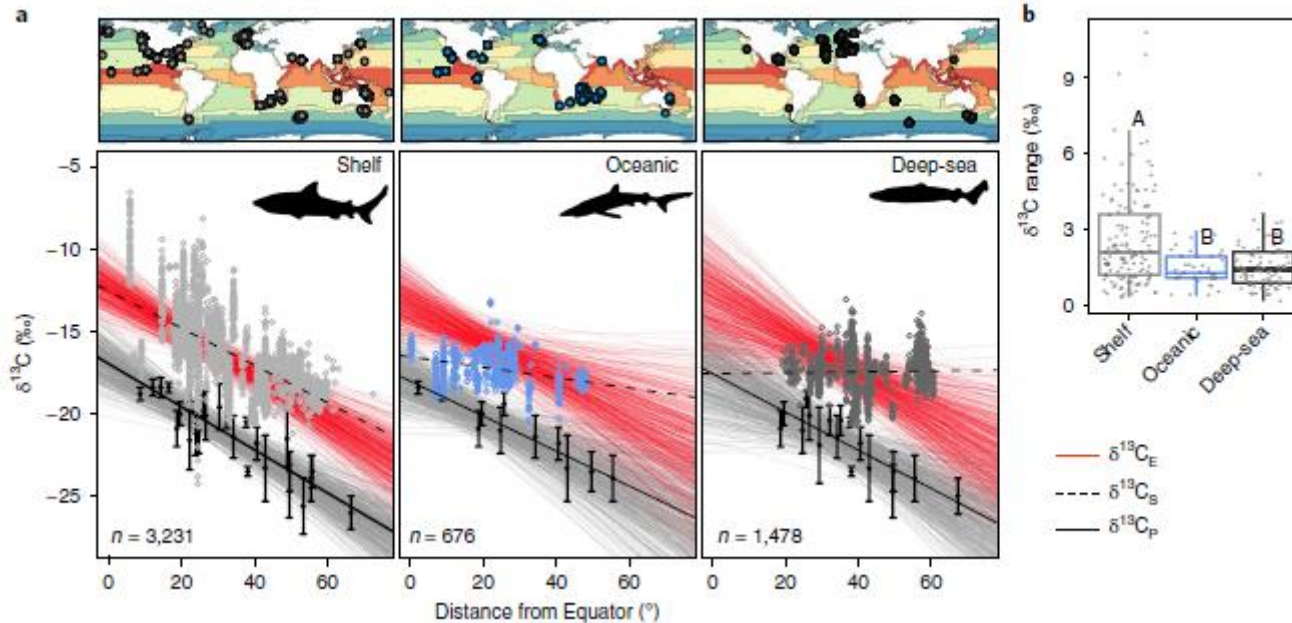
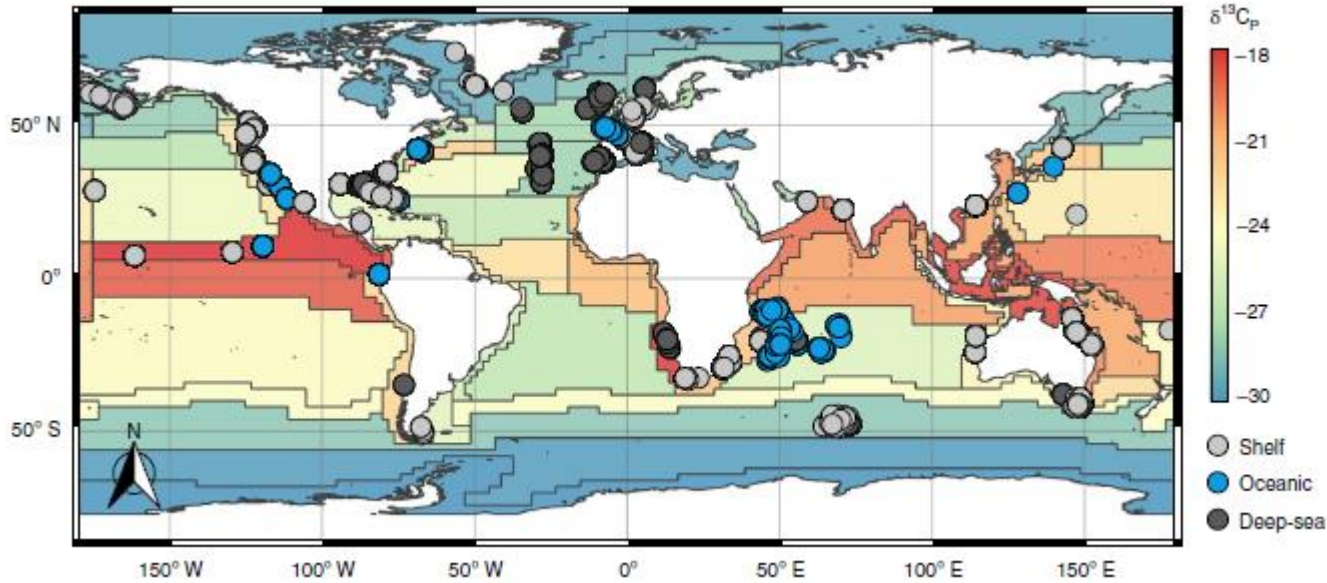
## A global perspective on the trophic geography of sharks

Christopher S. Bird<sup>1,71\*</sup>, Ana Veríssimo<sup>2,3</sup>, Sarah Magozzi<sup>1</sup>, Kátya G. Abrantes<sup>4</sup>, Alex Aguilar<sup>5</sup>, Hassan Al-Reasi<sup>6</sup>, Adam Barnett<sup>4</sup>, Dana M. Bethea<sup>7,72</sup>, Gérard Biais<sup>8</sup>, Asuncion Borrell<sup>9</sup>, Marc Bouchoucha<sup>9</sup>, Mariah Boyle<sup>10</sup>, Edward J. Brooks<sup>11</sup>, Juerg Brunnschweiler<sup>12</sup>, Paco Bustamante<sup>13</sup>, Aaron Carlisle<sup>14</sup>, Diana Catarino<sup>15</sup>, Stéphane Caut<sup>16</sup>, Yves Cherel<sup>17</sup>, Tiphaine Chouvelon<sup>18</sup>, Diana Churchill<sup>19</sup>, Javier Ciancio<sup>20</sup>, Julien Claes<sup>21</sup>, Ana Colaço<sup>15</sup>, Dean L. Courtney<sup>22,73</sup>, Pierre Cresson<sup>23</sup>, Ryan Daly<sup>24,25</sup>, Leigh de Necker<sup>26</sup>, Tetsuya Endo<sup>27</sup>, Ivone Figueiredo<sup>28</sup>, Ashley J. Frisch<sup>29</sup>, Joan Holst Hansen<sup>30</sup>, Michael Heithaus<sup>31</sup>, Nigel E. Hussey<sup>32</sup>, Johannes Iitembu<sup>33</sup>, Francis Juanes<sup>34</sup>, Michael J. Kinney<sup>35</sup>, Jeremy J. Kiszka<sup>36</sup>, Sebastian A. Klarian<sup>37</sup>, Dorothée Kopp<sup>38</sup>, Robert Leaf<sup>39</sup>, Yunkai Li<sup>40</sup>, Anne Lorrain<sup>41</sup>, Daniel J. Madigan<sup>42</sup>, Aleksandra Maljkovic<sup>43</sup>, Luis Malpica-Cruz<sup>44</sup>, Philip Match<sup>45,46</sup>, Mark G. Meekan<sup>47</sup>, Frédéric Ménard<sup>48</sup>, Gui M. Menezes<sup>15</sup>, Samantha E. M. Munroe<sup>49</sup>, Michael C. Newman<sup>50</sup>, Yannis P. Papastamatiou<sup>51,52</sup>, Heidi Pethybridge<sup>53</sup>, Jeffrey D. Plumlee<sup>54,55</sup>, Carlos Polo-Silva<sup>56</sup>, Katie Quaeck-Davies<sup>1</sup>, Vincent Raoult<sup>57</sup>, Jonathan Reum<sup>58</sup>, Yassir Eden Torres-Rojas<sup>59</sup>, David S. Shiffman<sup>60</sup>, Oliver N. Shipley<sup>61</sup>, Conrad W. Speed<sup>47</sup>, Michelle D. Staudinger<sup>62,63</sup>, Amy K. Teffer<sup>64</sup>, Alexander Tilley<sup>65</sup>, Maria Valls<sup>66</sup>, Jeremy J. Vaudo<sup>67</sup>, Tak-Cheung Wai<sup>68</sup>, R. J. David Wells<sup>54,55</sup>, Alex S. J. Wyatt<sup>69</sup>, Andrew Yool<sup>70</sup> and Clive N. Trueman<sup>1\*</sup>

**N=5394 sharks of 114 species!**

Shelf spp largely non migratory  
Vs. Oceanic and Deep Sea spp.

For migrants, C from 30° to 50° lat!



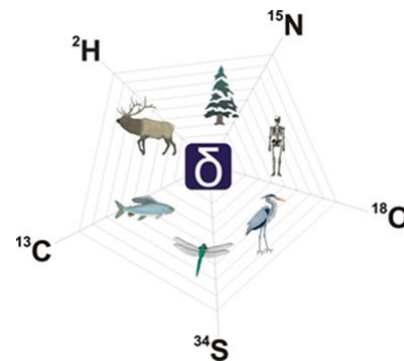
# Conclusion

- Good evidence that bulk tissue stable isotopes ( $^{13}\text{C}$ ,  $^{15}\text{N}$ ) can provide information on origins of sharks (and rays) **especially for coastal populations.**
- More sampling of known-origin sharks is needed to “calibrate” isoscapes.
- New frontier of compound-specific isotope techniques may provide greater resolution in the future.....



# Recommendations:

- Tissue sampling:
  - Easy! Only ~5mg of dried muscle needed. Can be stored at room temp.
- Combining techniques:
  - Genetic material = species identification
  - Isotopes = spatial and stock origins.
- Towards a tissue archive???
  - Coordinated use of seized material?



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