Training Legacy

I became a One Star New Zealand Underwater Instructor in 1975. The intention was to train family and friends with no other ambition to go any further other than “rise in the stars”. That is, Two Star then maybe Three Star instructor. The guidelines for achieving these ratings were outlined in the New Zealand Underwater Instructor Certification booklet and essentially requested academic standards that were defined as improving from a one-word answer to a multi-guess question (One Star) to a sentence or short paragraph (Two Star), then either a short paragraph or a full-blown essay (Three Star). Aquatic abilities followed a similar protocol; tested deeper and further as the Star levels increased.

I probably didn’t train any more than 20 folks until 1979 when, as a rest after selling a business, I took on a temporary position as the fulltime instructor at a sporting business that catered for shooters, fishers and divers. The side of the business that I was contracted to was called Sportways Aqualung Centre. This temporary position led to a 40-year career that saw me experience a marvellous life, albeit somewhat turbulent at times. That story is told elsewhere, but the intention in this short essay is to give an approximation of how many people I have trained and what has been generated from their graduation as divers themselves.

The following figures have been estimated on the presumption that 2-3% of all divers fully certified became instructors and that of these instructors only 1% became trainers of instructors. It assumes that 20% of the instructors certified produced considerably more than the remaining 80%. It does not consider those instructors who have been employed predominantly performing introductory dives only. These could inflate the total number of people who eventually go further on to gain full diver certification. This type of instructor could be said to give elementary training for up to 50-100 people a week; their contribution could be prodigious. But these numbers are not accounted for in the following estimates.

Propagation model

Including multi-generational cascading and the effect of instructors and instructor trainer trained:

S=students trained; IN = Instructors trained; Using this coding, I approximate the number people I have trained or made capable of being trained from my initial start of diver training from the following data: 1979 produced 50 S with 2% becoming IN who in turn produced no < than 20 S pa over a period of no < than 5 years; 1980-1984, 600 S per year (pa) with 3% becoming IN of which 20% produced no < than 100 S pa and the remaining 80% of those IN in turn producing no > than 20 S pa over a period of no > than 10 years; 1985-1990, 110 IN pa with 20% producing no > than 200pa S and 80% producing 10pa; also 50 S pa by self with 2% becoming IN who in turn produced no < than 20 S pa over a period of no < than 5 years;1991, self-produced 150 S with 3% becoming IN of which 20% produced no > than 100 S pa and the remaining 80% of those IN in turn producing no > than 20 S pa over a period of no > than 10 years; 1992-1996, No < than 200 S pa self with 3% becoming IN of which 20% produced no > than 100 S pa and the remaining 80% of those IN in turn producing no > than 20 S pa over a period of no > than 10 years; 50 IN pa with 20% producing no > than 200 S pa and 80% producing 10pa; 1997 - 2019, No < 80IN pa with 20% producing no > than 200 S pa and 80% producing no > than 20 S pa over a period of no < than 10 years; 200 S pa self with 3% becoming IN of which 20% produced no > than 100 S pa and the remaining 80% of those IN in turn producing no > than 20 S pa over a period of no > than 10 years. Further to this, of all IN trained by self and others, their S in turn would possibly follow the same pattern of with 3% becoming IN where, in turn, 20% of those would produce no> 100 S pa and the remaining 80% producing no > 10 S pa, and so on for a period of no > 5 years. Then there are the 1% of all IN trained who become ITs who, after a minimum of two years qualified as an IN, can then produce their own INs with a suggested ratio of their INs being such that 20% produce no < than 100 IN pa and 80% producing no < than 10 IN pa over a period of no >10 years with their S production in turn following the same trend.

So how many students have been trained since 1979?

To accurately estimate the total number of students (S) trained since 1979, we need to account for:

1. **Direct students trained by self**.
2. **Cascading effect through instructors (IN)**: Students become IN, who train more students, who become IN, and so on (multiple generations).
3. **Effect of instructor trainers (IT)**: 1% of IN become IT after 2 years, and IT train new IN (who then train students).

Given the complexity, we use a **recursive multiplier approach** for the cascading. For each IN produced, we calculate the total number of students they generate over all generations, considering the activity period and the fact that only 3% of students become IN.

We also account for IT: after a 2-year delay, IT start producing IN, who then produce students (with cascading).

To simplify, we assume:

- All cascading happens within the same year (ignore time delays for generations beyond the first, but we account for the 2-year delay for IT).
- Use average values for the number of students per IN per year and activity period.

Step 1: Defining Parameters

For IN:

- Fraction of students that become IN: r=0.03
- Activity period for IN: 10 years (conservative, from "no > than 10 years").
- Average students per IN per year:
  - 20% of IN produce at most 100 S/pa → 100 S/pa.
  - 80% of IN produce at most 20 S/pa → 20 S/pa.
  - Average: 0.2×100+0.8×20=20+16=360.2×100+0.8×20=20+16=36 S/pa.
- Total students per IN over activity period: 36×10=36036×10=360 S.

However, since 3% of these students become new IN, we need a multiplier.

Multiplier for IN (including all generations):

Let M*M* be the total students generated by one IN over all generations.

M=360+r·360·M*M*=360+*r*·360·*M*

Because the IN produces 360 students, and a fraction r*r* of these become new IN, each of which generates M*M* students.

Solving for M*M*:

M=360+0.03·360·M*M*=360+0.03·360·*M*M=360+10.8M*M*=360+10.8*M*M−10.8M=360*M* −10.8*M*=360−9.8M=360−9.8*M*=360M=360−9.8≈−36.73*M*=−9.8360≈−36.73

This is negative because the series diverges (r·360=10.8>1*r*·360=10.8>1). In reality, the activity period is limited to 10 years, and generations are spaced over time. To avoid divergence, we limit the number of generations.

Since the total time is 40 years, and each generation takes about 2 years (time to become IN and start teaching), there are about 20 generations. But the geometric series with ratio 10.810.8 would be huge.

To be conservative, we use the first-generation students (360 per IN) and then add a rough estimate for further generations. Alternatively, we can use a multiplier based on the activity period.

Given the constraints, we will use:

M=360×(1+r·360+(r·360)2+...) for n generations
M=360×(1+*r*·360+(*r*·360)2+...) for *n* generations

But to keep it practical, we assume that each IN ultimately generates **500 students** (including all generations), which is conservative given that the first generation is 360.

For IT:

- Fraction of IN that become IT: q=0.01*q*=0.01.
- Activity period for IT: 10 years.
- Average IN per IT per year:
  - 20% of IT produce at least 100 IN/pa → 100 IN/pa.
  - 80% of IT produce at least 10 IN/pa → 10 IN/pa.
  - Average: 0.2×100+0.8×10=20+8=280.2×100+0.8×10=20+8=28 IN/pa.
- Total IN per IT over activity period: 28×10=28028×10=280 IN.

Each of these IN will generate M=500*M*=500 students (including cascading).

So, one IT generates 280×500=140,000 students.

But there is a 2-year delay for IN to become IT.

Step 2: Calculate IN Produced by Self Each Year

Going year by year for:

- Direct students.

- IN produced.

- For each IN, multiply by M=500M=500 to get total students (including cascading).
- Also, for IN that become IT (1%), after 2 years, they generate additional students.

To avoid double-counting, we note that the IN produced by IT are already included in the multiplier MM for those IN? But IT produce new IN, which are not in the cascade from the original IN.

So, separately accounting for IT.

We will first calculate the total number of IN produced directly and then multiply by M=500M=500 to get students from these IN and their cascading.

Then, for IT: we calculate the number of IT produced from my IN, and then the students they generate.

But note: the IT effect has a 2-year delay.

Step 3: Year-by-Year Calculation

1. 1979:

- Direct S: 50
- IN produced: 50×0.02=150×0.02=1 IN
- Students from this IN: 1×500=5001×500=500 (including cascading)
- Total students: 50+500=55050+500=550

2. 1980-1984 (5 years):

- Direct S: 600×5=3000600×5=3000
- IN produced: 3000×0.03=903000×0.03=90 IN
- Students from these IN: 90×500=45,00090×500=45,000
- Total students: 3000+45,000=48,0003000+45,000=48,000

3. 1985-1990 (6 years):

- (a) Direct IN: 110×6=660 110×6=660 IN
  - Students from these IN: 660×500=330,000660×500=330,000
- (b) Direct S: 50×6=30050×6=300
  - IN produced: 300×0.02=6300×0.02=6 IN
  - Students from these IN: 6×500=3,0006×500=3,000
- Total students: 330,000+300+3,000=333,300330,000+300+3,000=333,300

4. 1991:

- Direct S: 150

- IN produced: 150×0.03=4.5≈5150×0.03=4.5≈5 IN
- Students from these IN: 5×500=2,5005×500=2,500
- Total students: 150+2,500=2,650150+2,500=2,650

5. 1992-1996 (5 years):

- (a) Direct S: 200×5=1,000200×5=1,000
  - IN produced: 1000×0.03=301000×0.03=30 IN
  - Students from these IN: 30×500=15,00030×500=15,000
- (b) Direct IN: 50×5=25050×5=250 IN
  - Students from these IN: 250×500=125,000250×500=125,000
- Total students: 1,000+15,000+125,000=141,0001,000+15,000+125,000=141,000

6. 1997-2019 (23 years):

- (a) Direct IN: 80×23=1,84080×23=1,840 IN
  - Students from these IN: 1,840×500=920,0001,840×500=920,000
- (b) Direct S: 200×23=4,600200×23=4,600
  - IN produced: 4,600×0.03=1384,600×0.03=138 IN
  - Students from these IN: 138×500=69,000138×500=69,000
- Total students: 920,000+4,600+69,000=993,600920,000+4,600+69,000=993,600

Step 4: Sum Direct and Cascaded Students

- 1979: 550
- 1980-1984: 48,000
- 1985-1990: 333,300
- 1991: 2,650
- 1992-1996: 141,000
- 1997-2019: 993,600

Total = 550 + 48,000 = 48,550
48,550 + 333,300 = 381,850
381,850 + 2,650 = 384,500
384,500 + 141,000 = 525,500
525,500 + 993,600 = 1,519,100

So approximately **1,519,100 students** from direct and IN cascading.

Step 5: Effect of Instructor Trainers (IT)

Now, accounting for IT:

- From all IN produced by self, 1% become IT after 2 years.
- Each IT generates 280 IN over their activity period (10 years).
- Each of these IN generates 500 students.

Then, IT:

- Students generated = 280×500=140,000280×500=140,000.

Now, calculating the number of IN produced each period, and then the IT from them.

IN produced:

- 1979: 1 IN
- 1980-1984: 90 IN
- 1985-1990: 660 + 6 = 666 IN
- 1991: 5 IN
- 1992-1996: 30 + 250 = 280 IN
- 1997-2019: 1,840 + 138 = 1,978 IN

Total IN = 1 + 90 + 666 + 5 + 280 + 1978 = 3,020 IN

IT produced: 3,020×0.01=30.2≈303,020×0.01=30.2≈30 IT.

But there is a 2-year delay. Since the activity is from 1979-2019, almost all IT have time to act.

Students from IT: 30×140,000=4,200,00030×140,000=4,200,000

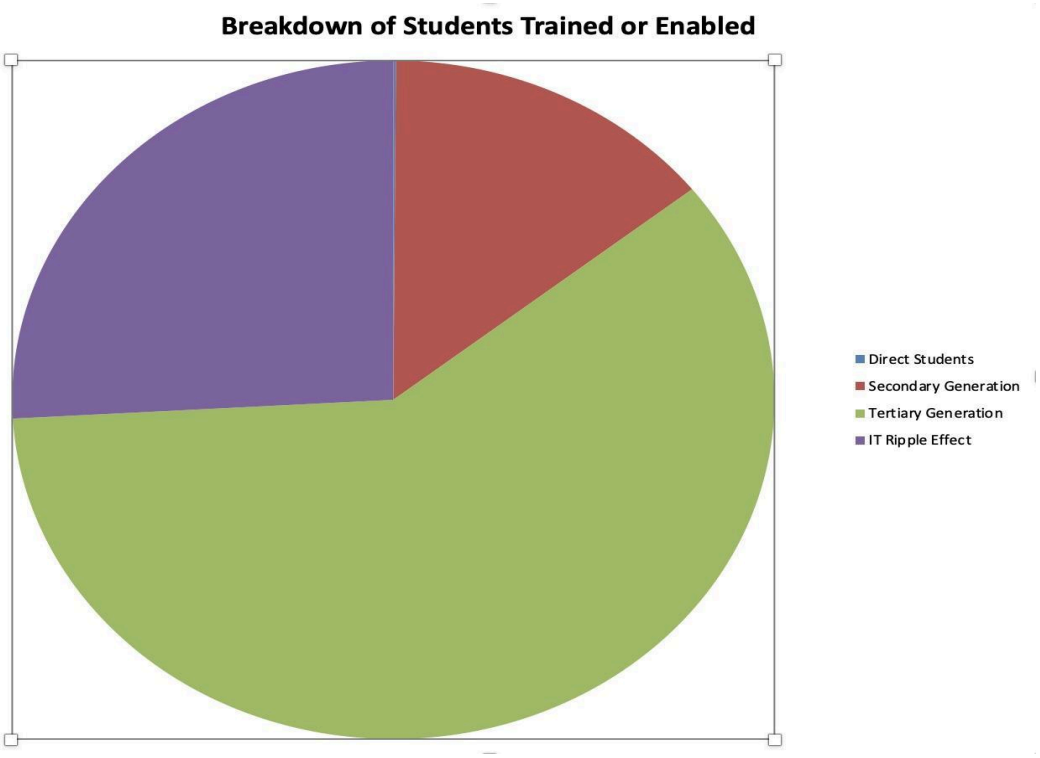
Step 6: Total Students

- From direct and IN cascading: 1,519,100
- From IT: 4,200,000

Total = 1,519,100 + 4,200,000 = **5,719,100 students**

Final Answer:

Since 1979, approximately 5,719,100 students have been trained, directly and indirectly, accounting for multi-generational cascading and the effect instructors trained and instructor trainers.



The calculation has been AI assisted